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A study of some of the factors affecting the grade and relationships of fresh and processed vegetables

IV. WHOLE KERNEL SWEET CORN FOR CANNING AND FREEZING

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*This is part IV of a series of publications on a study of the relationship of various grades of fresh and canned vegetables.

Part I of this series dealt with Canned Tomatoes (Preliminary Report April, 1953; final report OAES Res. Bull. 781, October 1956).

Part II of this series dealt with Canned Tomato Juice (Preliminary Report January 1954).

Part III of this series dealt with Canned Tomato Pulp (puree) (Preliminary Report July 1953).

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A STUDY OF SOME OF THE FACTORS AFFECTING THE GRADE AND RELATIONSHIPS OF FRESH AND PROCESSED VEGETABLES [1]

IV. Whole Kernel Sweet Corn For Canning and Freezing

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INTRODUCTION

Since the inauguration of Federal-State inspection service in Ohio in 1929, a study of the grade relationships and the advantages or disadvantages accruing to farmers and processors as a result of the service has been conducted only recently on tomatoes and tomato products.* An evaluation of varieties of sweet corn for processing, including degrees of maturity as they affect the quality of the processed product, as well as the development and application of methods of objectively measuring the maturity of raw and processed sweet corn, has been in progress at the Ohio Agricultural Experiment Station for the past several years (16, 18). However, little use has been made of the Standards for grades of sweet corn for canning in the State of Ohio, although the processed products are graded on the basis of the U. S. Standards for Grades.

There is an increasing need by the industry for objective quality determinations of both the raw and processed product to determine the effect of the quality of the raw product on the quality of the finished product on the basis of existing U. S. Standards. The objective of these

[1]This work was conducted as a part of cooperative project between the Ohio Agricultural Experiment Station and the U. S. Department of Agriculture under the Agricultural Marketing Act of 1946.

studies is to determine the relationship between raw and processed grades, and if possible to improve the usefulness of these standards of grades for fresh and processed corn.

REVIEW OF LITERATURE

The growing of sweet corn for processing purposes has been discussed in several publications (9, 10, 28). The heat unit system, growth-degree hours of growth-degree days has been used for estimating planting and harvest dates of peas, snap beans, and sweet corn. Lana and Haber (1952) (23) have reported that the degree-hour method of predicting the harvest date of sweet corn showed considerable seasonal variation and that it should only be used as an aid in scheduling planting dates.

Little work has been done in evaluating the U. S. Standards for Sweet Corn for Canning. However, when the Standards were first established, Reed and Miller (1937) (27) concluded that only sweet corn kernels which were tender and milky were suitable for packing as whole kernel corn, and that the purchase of this corn could be profitable for both the grower and the canner. In the present Standards, effective since February 15, 1945, (2) it is stated:

"The inspection reports are used at most canneries as a basis for ordering in much of the corn and as a basis for processing the corn in the factory.

"Although there are some variations in the percentages used, the following are the general practices used by canners in determining the proper disposition of each load of corn:

"Loads containing 50 percent or more Class A ears are canned as whole kernel corn.

"Loads containing less than 50 percent Class A ears are canned as cream style.

"Some canners make further separation of loads as follows:

"Loads containing 35 to 49 percent Class A ears are canned as "Fancy" cream style.

"Loads containing 20 to 34 percent Class A ears are canned as "Extra Standard" cream style.

"Loads containing less than 20 perecnt Class A ears are canned as "Standard" cream style.

"Many canners blend loads of different maturities to make one good uniform grade of cream style, and pack corn of the most advanced stage of maturity as "Standard" grade.

"The use of percentages based on actual weights gives canners a better opportunity to compare the relative maturity of different loads."

Considerable work has been done on the evaluation of maturity and quality of sweet corn. Appleman (1921) (7) observed that "green" sweet corn passed through the edible stage very rapidly and that the reliability of the "thumbnail" test varied with variety. Culpepper and Magoon (1924) (14) reported that with the varieties studied, canning should not be delayed much longer than the 20-day period after silking in order to obtain a better canned product. With respect to seasonal factors, Magoon and Culpepper (1926) (25) observed that temperature was the most important. Many varieties of sweet corn have been evaluated for raw and processed quality (8, 18).

Several workers (11, 15, 17, 24 and 26) have indicated that specific gravity could be used to measure the maturity of sweet corn. Burton (1922) (11) found that specific gravity could be used as a method of differentiating between old and young corn. When Culpepper and Magoon (1928) (15) applied specific gravity to totally removed kernels of sweet, dent, flour, flint and waxy types of corn, they observed that the density of the kernel varied with the stage of maturity and with types; there was little difference between the density of immature kernels; and the specific gravity of sweet corn, except in the immature stages, was less than that of the other types. Lee, DeFelice and Jenkins (1942) (24), determined specific gravity of frozen corn by weighing the thawed whole kernel corn in air and then in solutions and obtained high correlation coefficients when the specific-gravity values were correlated with organoleptic values. As a result of their study, they stated that fancy frozen whole kernel corn would have a specific-gravity value falling within the range of 1.080 to 1.118; reject due to immaturity could be 1.079 and lower; and reject because of overmaturity, 1.119 or higher Gould (1952) (17) used a modified National Potato Chip Institute potato hydrometer to measure the specific gravity of raw sweet corn and with an 8-pound sample established specific gravities for grades of canned corn. However, in a discussion of methods for testing the maturity of raw sweet corn, Mudra (1947) (26) concluded that the gravity test was the least reliable. The thumb-nail test, Brown-Duval moisture test, refractive idex method and specific gravity determination by brine floatation were represented in his work.

The point of sampling during the processing for objective tests has been shown to be as important as the objective methods themselves in interpreting the results (12). The subjective methods generally used to evaluate canned and frozen whole kernel corn are those set forth in the U. S. Standards (3, 4). Some of the objective methods used to determine quality of sweet corn are: Alcohol Insoluble Solids (A.I.S.), Moisture tests, succulence with the Succulometer, soluble solids with the refractometer, pericarp content, and kernel-diameter measurements. Gould, Krantz, and Mavis (1951) (16) reported that the A.I.S. is the most reliable method of determining the maturity of fresh, frozen and canned yellow sweet corn. Kramer (1952) (22) combined several objective tests in order to predict the U. S. Grade of Canned Sweet Corn by means of the Tenderness and Maturity Score. Twigg, et.al. (1956) (29) prepared nomographs for determining the U.S. Grades of Canned and Frozen Whole Kernel Sweet Corn by means of determining the Tenderness and Maturity Factor with objective tests. Henry et.al. (1956) (20) recently evaluated some objective methods to determine maturity in relation to yield and quality of yellow sweet corn, and found that moisture determinations were applicable tests for maturity and that the A.I.S. was the most consistent method.

EXPERIMENTAL METHODS

Varieties:

Research work was started during the 1953 corn canning season and continued through the 1955 season. Tendermost and Victory Golden, two important hybrids in general use, were the varieties used throughout this study. The sweet corn grew on the Horticulture farm at the Ohio State University, Columbus, Ohio.

Growing Practices:

During the 3 years, 1953, 1954, and 1955, the sweet corn was grown in accordance with acceptable commercial practice for the production of canning corn in Ohio. Throughout the growing period there were no disease or insect control practices used.

The first of the 4 plantings of both Tendermost and Victory Golden was made on May 21 in 1953, May 20 in 1954, and May 13 in 1955. Each of the subsequent plantings of each year were made after approximately 100 growth-degree day units had accumulated, (Table 1). Starting with the appearance of first tassels in the first planting and at approximately 4-day intervals thereafter, observations of the growing plant and maturity ear were made in the field. The observations are recorded in Appendix Tables A, B and C.

TABLE 1.—The planting dates of the sweet corn varieties, Tendermost and Victory Golden, during the years 1953, 1954 and 1955. (O. S. U. Horticulture Farm, Columbus, Ohio)

Date	Planting			
	1	2	3	4
5–21–53	×			
5–26–53		×		
5–20–54	×			
5–25–54		×		
5–28–54			×	
5–13–55	×			
5–21–55		×		
5–26–55			×	
6– 1–53			×	
6– 5–53				×
6– 7–54				×
6– 2–55				×

The first harvest in 1953 and 1954 was made on August 10, and on August 6 in 1955; harvesting was continued until September 9 in 1953, September 11 in 1954, and August 30 in 1955 with 2- to 4-day intervals between most pickings. All the harvest dates by year and plantings for the 2 varieties are listed in Table 2.

The yield, maturity classification, and accumulated heat units (growth-degree days) following the planting and harvest plans (Table 1 and 2) are given in Appendix Tables D, E, and F.

Grading Raw Product:

At each harvest, each lot as harvested (Appendix Table D) was graded by a Federal-State fresh fruit and vegetable inspector. During the years 1953 and 1954 the raw products inspector graded a separate 50-pound lot according to the U. S. Standards for Sweet Corn for Canning (2). However, during all three years all ears were graded into the three maturity classes, A, B, and C which are set forth in the U. S. Standards for Sweet Corn for Canning (2) as follows:

"**Class A** shall consist of ears of sweet corn, the kernels of which are tender and milky. ('Tender' means that the kernels break with only moderate pressure from the thumb nail.)

"**Class B** shall consist of ears of sweet corn the kernels of which do not meet Class A requirements for tenderness or which have developed

TABLE 2.—The harvest dates for the sweet-corn varieties, Tendermost and Victory Golden for the years 1953, 1954 and 1955

Year	Planting	Harvest and harvest date							
		Tendermost				Victory Golden			
		1	2	3	4	1	2	3	4
1953	1	8–10	8–12	8–14	8–19	8–10	8–12	8–14	8–17
	2	8–21	8–24	8–26	8–28	8–19	8–21	8–24	8–26
	3	8–31	9– 2	9– 2	9– 4	8–26	8–28	8–31	9– 2
	4	9– 9	9– 9	----	----	9– 2	9– 4	----	----
1954	1	8–10	8–14	8–17	8–23	8–17	8–18	8–20	8–27
	2	8–18	8–20	8–27	9– 1	8–23	8–25	8–30	8–30
	3	8–25	8–30	8–30	9– 9	9– 1	9– 1	9– 7	----
	4	9– 3	9– 3	9– 7	9–11	9– 3	9– 9	9–11	----
1955	1	8– 6	8– 9	8–11	8–15	8– 9	8–11	8–15	8–18
	2	8–15	8–18	8–19	8–23	8–19	8–24	----	----
	3	8–23	8–26	8–29	----	8–22	8–24	8–26	----
	4	8–24	8–27	8–30	----	8–23	8–27	8–29	----

beyond the stage at which the kernels are milky and the exudate is of a heavy consistency, but the kernels are not appreciably dented from overmaturity."

"**Class C** shall consist of ears of sweet corn which are appreciably dented from overmaturity."

The inspection procedure for the total samples was as follows:

1. Weigh the entire harvested lot and record, (Figure 1).
2. Husk on a mechanical husker.
3. Grade husked ears into 3 maturity classifications in accordince with U. S. Standards for Sweet Corn for Canning.
4. Weigh and calculate percentage of the respective classifications and record, (Figure 1).
5. Cut corn from each maturity classification, weigh, calculate percent cut-off and record, (Figure 1).

Appendix Tables D, E, and F include the percent cut-off and percent A. I. S. of the 3 maturity classifications (A, B, and C) for the 2 varieties (Tendermost and Victory Golden) over the 3-year period (1953, 1954, and 1955).

Figure 1.—USDA Raw Product Sample Data

Lot No. _____ : _____Variety_____Date:_____

U. S. No. 1 Husked ears: _____lbs;_____percent

U. S. No. 2 Husked ears: _____lbs;_____percent

U. S. Culls Husked ears: _____lbs:_____percent

TOTAL: _____ _____percent

Maturity classification of husked ears:

Class A: _____lbs;_____percent_____count

B: _____lbs;_____percent_____count

C: _____lbs;_____percent_____count

Culls _____count

TOTAL: _____lbs;_____percent_____count

CUT OFF OF HUSKED EARS:

Class A: _____lbs;_____percent

B: _____lbs;_____percent

C: _____lbs;_____percent

_____
Inspector

Processing Methods:

After grading the corn into the respective maturity classifications, the corn of each lot by variety and maturity classification was processed into whole grain canned corn and whole grain frozen corn.

The specific procedures for each processed product are given below.

A. Whole Grain Canned Corn.

1. Harvest corn by plantings—4 harvests or lots per planting (Lot constitutes one variety at each picking. 16 lots per variety per season in most cases).
2. Husk corn with mechanical corn husker.
3. Sort corn, (by Federal-State fresh fruit and vegetable inspector) into maturity classes (A, B and C), weigh and calculate percent of each.
4. Trim, soak, wash and clean corn on the cob.

5. Cut corn on mechanical corn cutter with knives adjusted to give full cut for each maturity class. Weigh cut corn and calculate percent cut-off.
6. Wash and desilk corn in rod-reel washer.
7. Remove defective kernels, pieces of cob and silk on continuous inspection belt.
8. Blanch cut corn in a continuous live steam blancher to inactivate enzymes and cool to 75°–85° F. immediately by spray washing.
9. Fill into No. 2 size C-enamel cans (approximately 12 ounces).
10. Cover with boiling water containing sodium chloride. (1.5% or 0.1246 lbs. salt per gallon of water).
11. Exhaust corn in continuous live steam exhauster.
12. Code and seal can.
13. Process in nonagitating retort for 25 minutes at 250° F.
14. Cool promptly to 100° F. in cold water.

B. Whole Grain Frozen Corn.

1–8. Steps 1-8 above for whole grain canned corn were followed for whole grain frozen corn.
9. Fill into No. 2 "C" enamel cans (approximately 16 ounces) code, and seal cans using steam flow (15 p. s. i.) closure.
10. Immediately freeze to 0° F. on a —20° F. single contact plate freezer.
11. Store product at 0° F. in nonfluctuating temperature storage.

Quantity Packed:

During the 3 years, a total of 113 lots (approximately 5000 cans) of canned and frozen corn were processed. This amounted to 36 (16 Tendermost, 20 Victory Golden), 38 (19 each variety), and 39 (19 Tendermost, 20 Victory Golden) lots for the 1953, 1954 and 1955 seasons respectively.

Grading of Finished Product:

After approximately 2-, 6-, and 14-months storage, samples from the respective processed products were graded by the U. S. D. A. Processed Products Inspection Service in accordance with the respective standards for grades for the different products (3, 4). However the 14 month evaluation was omitted for the corn packed during the 1955 season. A summary of the score points for each factor of the different products is presented in Tables 3 and 4. However, the details of the interpretation of each grade of the grade factors are described in the U. S. Standards for Grades of Canned and Frozen Whole Kernel Corn (3, 4).

TABLE 3.—U. S. Standard for Grades of Canned Whole Kernel Corn (3)

	Score Points			
	Grade A	Grade B	Grade C	Grade D
Color	9– 10	8	6– 7*	0– 5†
Cut	9– 10	8	6– 7†	0– 5†
Absence of defects	18– 20	16–17†	14–15†	0–13†
Tenderness and maturity	36– 40	32–35†	30–31†	0–29†
Flavor	18– 20	16–17	14–15†	0–13†
Total score	90–100	80–89	70–79	0–69

*Indicates partial limiting rule as defined in the U. S. Standards (3).
†Indicates limiting rule as defined in the U S. Standards (3).

TABLE 4.—U. S. Standards for Grades of Frozen Whole Kernel Corn (4)

Factors	Score Points			
	Grade A	Grade B	Grade C	Grade D
Color	9– 10	8	6– 7*	0– 5†
Absence of defects	36– 40	32–35†	28–31†	0–27†
Tenderness and maturity	45– 50	40–44†	36–39†	0–35†
Total score	90–100	80–89	70–79	0–69

*Indicates partial limiting rule as defined in the U. S. Standards (4).
†Indicates limiting rule as defined in the U. S. Standards (4).

Objective Quality Evaluation:

Objective quality analyses were made on all lots immediately after cutting, after washing (excepting the 1955 season), after blanching, and after each grading of the frozen and of the canned products. The methods are:

A. A. I. S. Determination—F & DA method (6). (The A. I. S. data for the whole kernel corn for the various steps during processing are presented in Appendix Table L.)

B. Succulence—Kramer's method (21) was used for determining the succulence of each lot of corn. (The succulence data for whole kernel corn for the various steps during processing are presented in Appendix Table N.)

C. Soluble Solids—The soluble solids content was determined by taking a representative sample, macerating in a mortar with a pestle, expressing through a cheese cloth, and measuring the soluble solids content on an Abbe "56" Refractometer. (The soluble solids data for the whole kernel corn for the various steps during processing are presented in Appendix Table K.)

D. Moisture Content—The moisture content was determined in two ways: (a) Vacuum Oven Method and (b) Steinlite Method; however, the Steinlite instrument was not available until after the end of the 1953 season. Therefore, moisture was determined by the vacuum over method only during the 1953 season, and the moisture tests were only applied to the cut, washed and blanched whole kernel corn samples. (The moisture values for the various steps during the processing are presented in Appendix Table J.)

   a. Vacuum Oven Method:
      1. Weigh representative samples (25 grams) of corn into previously weighed drying dishes.
      2. Pre-dry the weighed sample in a ventilated oven at 100° C. for 1 hour.
      3. Dry the sample in a vacuum oven (26 inches of vacuum at 70° C.) overnight. During the drying a slow current (about 2 bubbles per second) of dry air (dried by passing through concentrated sul-furic acid) was passed through the vacuum chamber.
      4. After the drying period, cool the sample contained in a drying dish in a desiccator.
      5. Reweigh and calculate the percent-moisture content by subtracting the weight of the dried corn from the fresh weight and multiplying this difference by four.
   b. Steinlite Method (1)

E. Pericarp—The pericarp was determined in accordance with the Ohio State University Method (16). (The pericarp values for the whole kernel corn for the various steps during processing are presented in Appendix Table M.)

F. Specific-gravity Techniques (13)—The specific-gravity principle was applied by means of weighing the sample in water. Specific gravity was determined on processed samples from the 1954 and 1955 seasons and the raw product during the 1955 season.

Difference in weight methods employing 6 pound and approximately 100-gram sample sizes were used as follows:

1. Drain the sample for 2 minutes and weigh a representative either a 6 pound or an approximately 100-gram sample in air and then in water of known specific gravity as rapidly as possible.

2. The weight of the corn in air multiplied by the specific gravity of the water, divided by the difference of the weight of the corn in air and the weight in water equaled the specific gravity of the corn.

$$\text{Specific gravity} = \frac{\text{Wt. in air} \times \text{specific gravity of water}}{(\text{Wt. in air} - \text{Wt. in water})}$$

The 6-pound method was used only at the raw cut and blanched sample points, and the 100-gram method was used on raw cut, blanched and processed samples. The specific-gravity values obtained during the processing and storage are summarized in Appendix Tables O and P.

Experimental Results:

The results of this grade-relationship study on canned and frozen whole kernel sweet corn are presented as follows:

A. relationship between raw grade (subjective evaluation) and finished grade (subjective evaluation)

B. relationship between raw grade (subjective evaluation) and specific objective methods of determining raw corn maturity

C. relationship between finished product grades (U. S. D. A. Tenderness and Maturity Factor) and specific objective methods of determining canned and frozen corn maturity

D. relationship between finished grade of canned and frozen corn and specific objective methods of raw corn maturity

E. relationship between objective measurements of quality between raw and processed product, and the effect of specific processing variables on quality retention

F. relationship between raw maturity classification and percent cut-off (yield)

G. specific gravity, a method for the evaluation of raw, canned and frozen whole kernel corn maturity

Where possible, the data for each of these relationships are interpreted statistically[2], summarized in tabular form, and presented graphically in the following sections. The detailed data are presented in Appendix Tables with the climatological data presented in Appendix Chart I.

A. **Relationship between Raw Grade (Subjective Evaluation) and Finished Grade (Subjective Evaluation).**

1. Canned product-variety effect.

This grade relationship from a subjective evaluation standpoint is summarized for the canned product in Table 5. These data indicate a reasonably good relationship between the raw and finished grade except that the finished grade was usually displaced one grade lower than the raw grade. From Class A maturity raw corn, a canner can expect on an average to pack only Extra Standard, or Grade B corn, because the Tenderness and Maturity factor is scored in the Grade B range. From Class B maturity raw corn, the canner, when using Tendermost variety corn, cannot even expect to pack Standard or Grade C quality because the Tenderness and Maturity and Flavor factors scored in the Substandard or Grade D range. However, when using the variety Victory Golden, the canner should expect to obtain

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[2]For the reader not familiar with the statistical terminology as used in this bulletin, the following statements are presented (more detailed information is available in books such as: A. V. Fergenbaum's **Quality Control; Principles, Practice and Administration,** McGraw-Hill Book Co., Inc., New York (1951); E. L. Grant's **Statistical Quality Control,** McGraw-Hill Book Co., Inc., New York (1946); and others dealing with the use of statistics in quality control):

Average values (x) were calculated by totaling each of the individual observations and dividing by the total number of observations (N). Standard deviation δ was calculated by taking the root-mean square of the deviations (d) of individual observations from the average (x).

Thus $\delta = \sqrt{\frac{S\,(d^2)}{N}}$

Mean square of the error (Sx) was calculated by dividing the standard deviation (δ) by the square root of the number of observations (N). Thus: $Sx = \frac{S}{\sqrt{N}}$

The coefficient of variability (V) was calculated by dividing the standard deviation (δ) by the mean (x) and then multiplying by 100.

Thus: $V = \frac{\delta}{x} \times 100$. This is a measure of relative dispersion.

1.4 multiplied by sigma is the plus or minus deviation from the mean (x) within the range in which 84 percent of the observations are included.

Grade C or Standard quality from Class B maturity raw corn. According to these studies, when values for the varieties are averaged, the canner cannot expect to pack anything above Grade D or Substandard canned whole kernel corn when using Class C raw corn because of extremely low scores for the factors Tenderness and Maturity and Flavor.

2. Canned product-seasonal effect by varieties.

The data presented in Table 5 indicate quite clearly that seasonal effects are as important as variety effects on these grade relationships. Within any one of the 3 seasons the varieties still follow the same pattern that is explained above, i. e. Victory Golden for any given maturity class of raw corn was quite superior to Tendermost in giving a more direct and better grade relationship. The canned corn packed in the 1954 season had the poorest grade relationship, while the canned corn from the 1955 season had by far the best grade relationship. These statements are true for all maturity classifications. Please note, also, that no Class C corn was canned during 1955 season.

3. Frozen product—variety effect.

The grade relationship of the frozen corn by raw product classification is summarized in Table 6. For both varieties, the freezer could expect a Grade A pack from Class A maturity raw corn. However, from raw product Class B corn there were some variations between varieties. Tendermost averaged Grade C and Victory Golden Grade B, with the Tenderness and Maturity grade factor being the limiting factor in both cases. When values for the 2 varieties are averaged for all 3 years, the frozen product was Grade C, again with the Tenderness and Maturity scores being the limiting grade factor. With Victory Golden the freezer could expect to pack Standard or Grade C frozen whole kernel corn from Class C, but the Class C Tendermost raw corn produced Substandard or Grade D frozen corn due to the Tenderness and Maturity score being the limiting grade factor. Further, these data indicate that a freezer could expect nothing better than Substandard frozen corn from Class C raw corn when the data for the 2 varieties are averaged.

4. Frozen product—seasonal effects by variety.

The data presented in Table 6 indicate that there was a good grade relationship for raw corn of Class A maturity for all 3 years. However, even though all raw product Class A produced all Grade A frozen corn, the trend of lower scores for the 1954 pack is still persistent; the tenderness and maturity factor being the grade factor scoring

TABLE 5.—Relationships between raw product classifications and grades of canned whole kernel yellow sweet corn for two varieties over three years

Raw product class	Variety	Year	Repl.[1]	U. S. D. A. Score Points						
				Color	Cut	Absence of defects	Tend. & mat.	Total Flavor	Total Score	Grade
A	T	1953	26	8.83	8.42	18.15	35.50†	17.60	88.50	B
		1954	33	8.71	8.30	18.47	32.82†	15.40†	83.70	C
		1955	30	9.47	8.27	18.94	35.97†	17.97	90.60	B
		Average		9.00	8.32	18.53	34.66†	16.91	87.43	B
	VG	1953	33	8.87	8.44	18.05	35.98†	17.83	89.15	B
		1954	30	8.85	8.33	18.50	34.18†	16.65	86.51	B
		1955	26	9.62	8.39	18.94	37.64	19.27	93.85	A
		Average		9.08	8.39	18.46	35.86†	17.85	89.63	B
	T & VG	1953	59	8.85	8.43	18.09	35.77†	17.73	88.86	B
		1954	63	8.78	8.31	18.48	33.47†	16.00	85.04	B
		1955	56	9.54	8.32	18.94	36.74	18.57	92.11	A
	Grand	Average		9.04	8.36	18.50	35.26†	17.38	88.47	B
B	T	1953	12	9.42	8.71	18.54	29.91†	14.38†	80.96	D
		1954	18	7.89†	8.20	17.86†	24.34†	10.39†	68.64	D
		1955	8	9.13	8.25	18.57	33.13†	16.00	85.06	B
		Average		8.63	8.37	18.22	27.95†	12.83†	75.99	D
	VG	1953	15	9.10	8.63	18.36	33.86†	16.78	86.75	B
		1954	15	8.15	8.33	18.47	29.40†	13.48†	77.85	D
		1955	11	9.82	8.36	19.00	35.36†	18.09	90.64	B
		Average		8.94	8.45	18.57	32.63†	15.92†	84.54	C
	T & VG	1953	27	9.24	8.66	18.44	32.10†	15.71†	84.18	C
		1954	33	8.01	8.26	18.14	26.64†	11.79†	72.83	D
		1955	19	9.53	8.31	18.82	34.42†	17.21	88.29	B
	Grand	Average		8.80	8.41	18.40	30.38†	14.44†	80.42	C
C	T	1953	1	10.00	9.00	19.00	27.50†	10.00†	75.50	D
		1954	6	7.83*	8.33	18.17	19.33†	7.33†	61.00	D
		Average		8.14	8.42	18.29	20.50†	7.71†	63.07	D
	VG	1953	3	8.83	8.83	18.33	33.50†	16.50	86.00	B
		1954	8	8.19	8.38	18.50	25.66†	10.76†	71.48	D
		Average		8.36	8.50	18.45	27.80†	12.32†	75.44	D
	T & VG	1953	4	9.12	8.87	18.50	32.00†	14.88†	83.38	D
		1954	14	8.04	8.36	18.36	22.95†	9.29†	66.99	D
	Grand	Average		8.28	8.47	18.39	24.96†	10.66†	70.63	D

*Indicates partial limitinf rule.

†Indicates limiting rule.

Variety—T=Tendermost; VG=Victory Golden.

[1]Repl.=Replicates.

TABLE 6.—Relationships between raw product classifications and grades of frozen whole kernel yellow sweet corn for two varieties over three years

Raw product class	Variety	Year	Repl.[1]	U. S. D. A. Score Points				
				Color	Absence of defects	Tenderness & maturity	Total score	Grade
A	T	1953	25	9.17	37.81	46.78	93.76	A
		1954	33	9.03	38.18	45.15	92.36	A
		1955	26	9.79	38.82	46.56	95.18	A
		Average		9.31	38.27	46.07	93.65	A
	VG	1953	31	8.82	37.70	47.52	94.04	A
		1954	30	8.93	37.95	45.53	92.42	A
		1955	24	9.73	38.98	47.92	96.63	A
		Average		9.12	38.15	46.93	94.20	A
	T & VG	1953	56	8.98	37.75	47.19	93.92	A
		1954	63	8.98	38.07	45.33	92.39	A
		1955	50	9.76	38.90	47.21	95.88	A
	Grand	Average		9.21	38.21	46.50	93.93	A
B	T	1953	21	8.91	38.01	40.00†	86.91	B
		1954	18	7.83*	37.50	30.61†	75.95	D
		1955	10	9.70	38.90	44.90†	93.50	B
		Average		8.67	38.00	37.55†	84.23	C
	VG	1953	16	8.79	37.67	45.71	92.17	A
		1954	15	8.13	37.83	37.07†	83.03	C
		1955	9	9.78	39.00	46.44	95.22	A
		Average		8.76	38.03	42.63†	89.43	B
	T & VG	1953	37	8.86	37.86	42.47†	89.18	B
		1954	33	7.97	37.65	33.55†	79.17	D
		1955	19	9.74	38.95	45.63	94.31	A
	Grand	Average		8.72	38.01	39.84†	86.57	C
C	T	1953	3	7.83*	36.67	28.83†	73.33	D
	VG	1953	2	8.25	35.75†	39.50†	83.50	C
	Grand	Average		8.00	36.30	33.10†	77.40	D

*Indicates partial limiting rule.

†Indicates limiting rule.

Variety—T=Tendermost; VG=Victory Golden.

[1]Repl.=Replicates.

low. According to these data, the frozen corn packer could still expect to pack Grade A frozen whole kernel corn from Class A. The seasonal variation was particularly accentuated with the Class B maturity. The grade relationship of Class B Tendermost appeared very good for the 1953 and 1955 seasons, but in 1954 the frozen product graded Substandard or Grade D. Demonstrating a similar trend, Class B raw Victory Golden corn graded Fancy in 1953 and 1955, but in 1954 this maturity class of raw corn only graded Standard or Grade C. When the data for both varieties were averaged, Class B raw corn for the 1954 season was graded as Grade D frozen corn while the 1953 and 1955 frozen corn graded B and A respectively. Class C maturity raw corn was frozen only in 1953. The corn from the Tendermost variety graded Substandard or Grade D while the corn packed from the Victory Golden variety graded Standard or Grade C.

B. Relationship between Raw Grade (Subjective Evaluation) and Specific Obective Methods of Determining Raw Corn Maturity.

In the grading of raw corn, the inspector relies on the "thumb-nail" test to determine the maturity class. This phase of the bulletin shows the relationship between the inspector (subjective evaluation) and specific objective tests of corn quality. Detailed data between the varieties for the 3 maturity classes by years are presented in Appendix Tables J, K, L, M and N. Some of the more important relationships; however, are shown in Charts 1 through 10. The general trend for moisture content is shown in Chart 1 for the 2 varieties averaged for the 3 years by maturity Class A. Chart 2 for corn of maturity Class B shows a decrease in moisture values of 5.4 percent from the moisture values for the Class A maturity. However, when 84 percent of the moisture values (Mean $\pm$ 1.40) were considered, approximately 25 percent of the samples of the two maturity classes were found to have the same moisture content. In other words, when the overall data are examined, no sharp dividing line is evident for the 2 maturity classes.

Some of this wide dispersion in moisture values can be explained by examining these data by varieties. Charts 3 through 6 show that samples processed from the variety Victory Golden in maturity Class A has only approximately one-half the spread in moisture values as were found for the samples from corn processed from the variety Tendermost (69.7 $\pm$ 3.76 for Victory Golden to 69.4 $\pm$ 6.19 for Tendermost). Chart 3 depicts this difference even more strikingly as the spread in moisture values for the variety Victory Golden is in the upper range rather than the lower range. These data in Charts 4 and 6 depict this problem more acutely. Here it can be seen that the Class B corn from

the variety Victory Golden has an average moisture value of 65.9 while Class B corn from the variety Tendermost has only 62.3 moisture content. The upper limits for moisture values from the Victory Golden variety corn are more sharply defined, while for the variety Tendermost no sharply defined moisture limits existed.

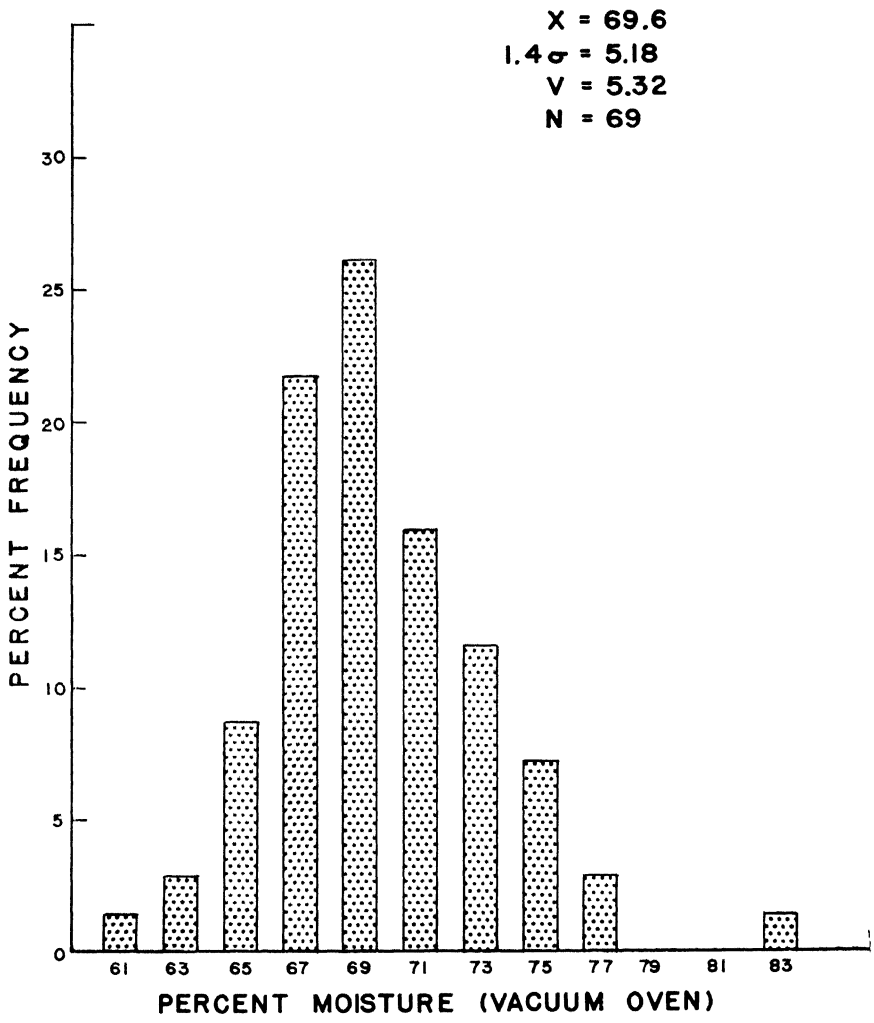


Chart 1.—Frequency distribution of moisture values (vacuum oven) of Class A Victory Golden and Tendermost sampled after the cutting operation 1953, 1954 and 1955.

These data show clearly that variety is a significant factor in determining maturity classification. Further, it is shown quite clearly that the subjective maturity classification as determined by the inspector are not specific if moisture values can be used as a criterion of maturity

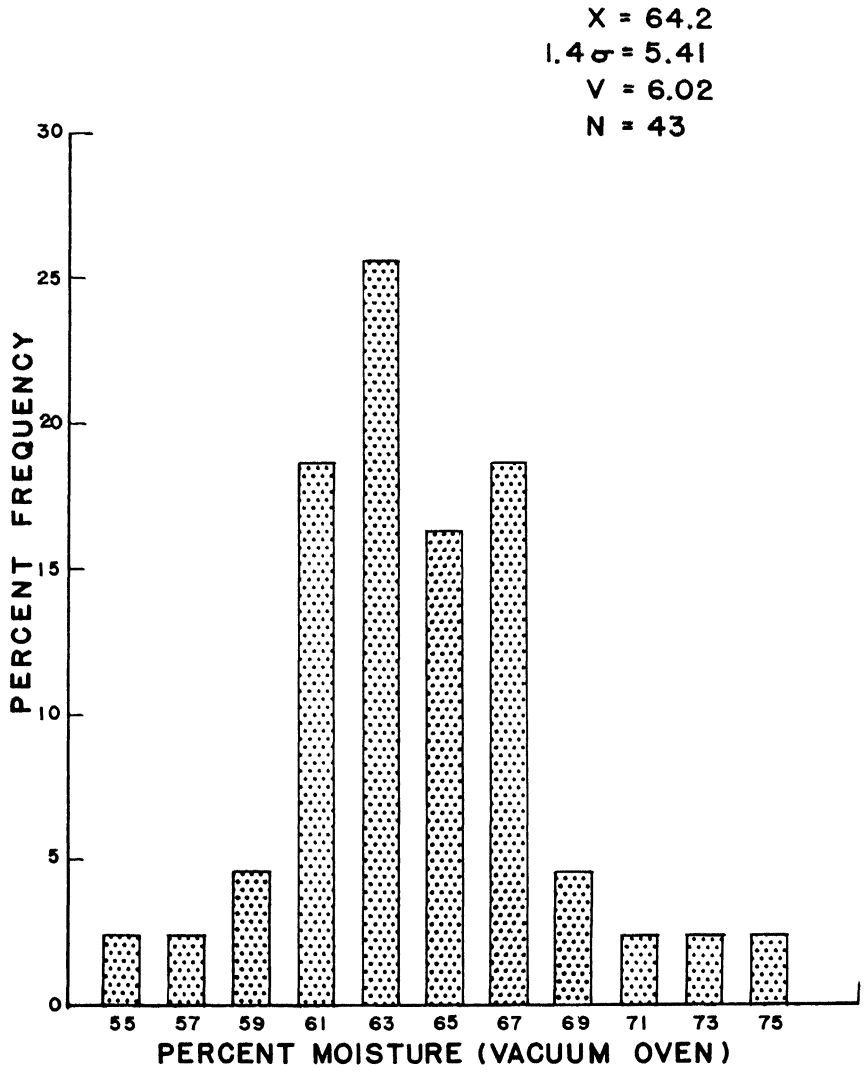


Chart 2.—Frequency distribution of moisture values (vacuum oven) of Class B Tendermost and Victory Golden sampled after the cutting operation 1953, 1954 and 1955.

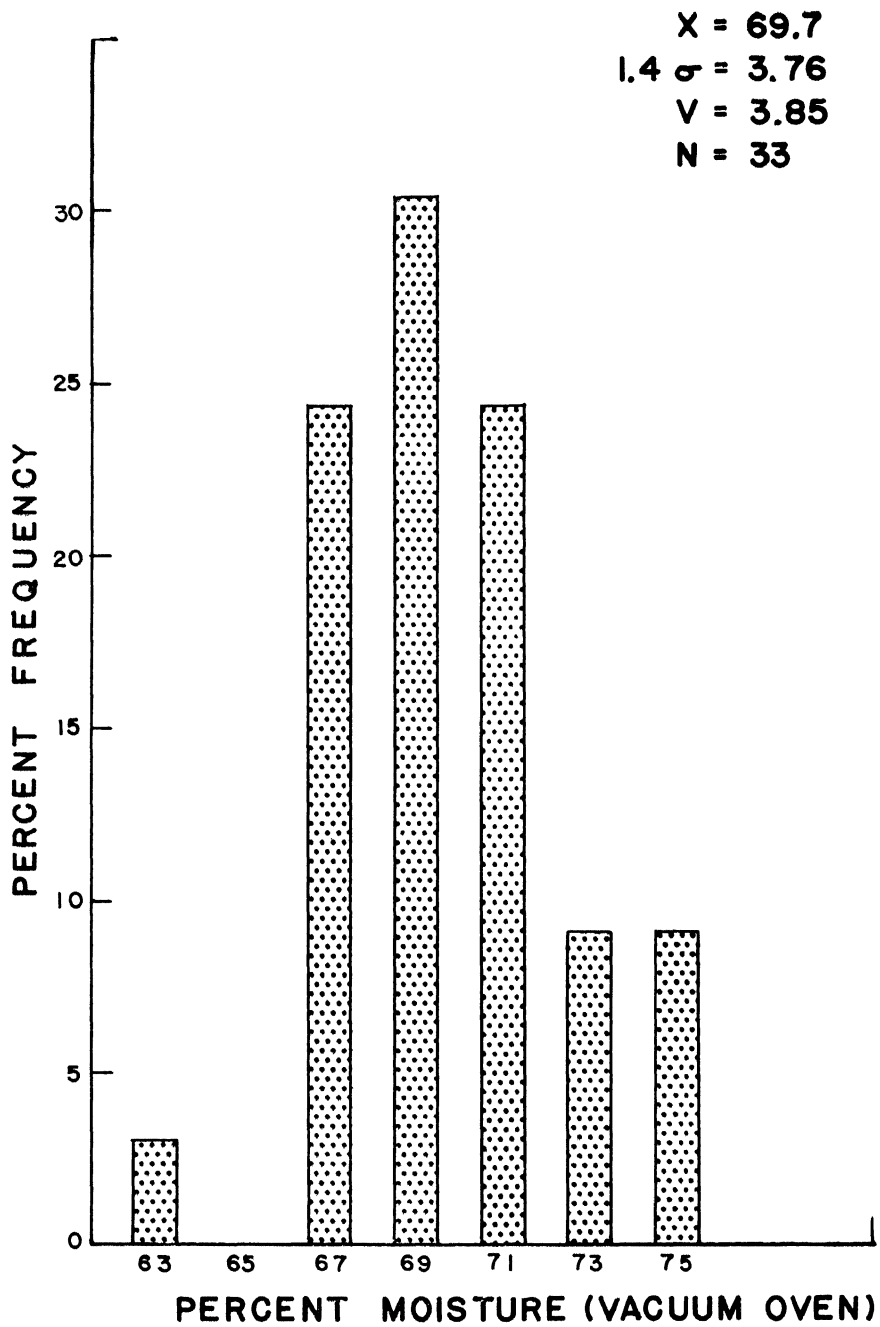


Chart 3.—Frequency distribution of moisture values (vacuum oven) of Class A Victory Golden sampled after the cutting operation 1953, 1954 and 1955.

classification. It would appear from these data that the inspector tends to base his maturity classifications on moisture content, but at different values depending on variety and period of the packing season.

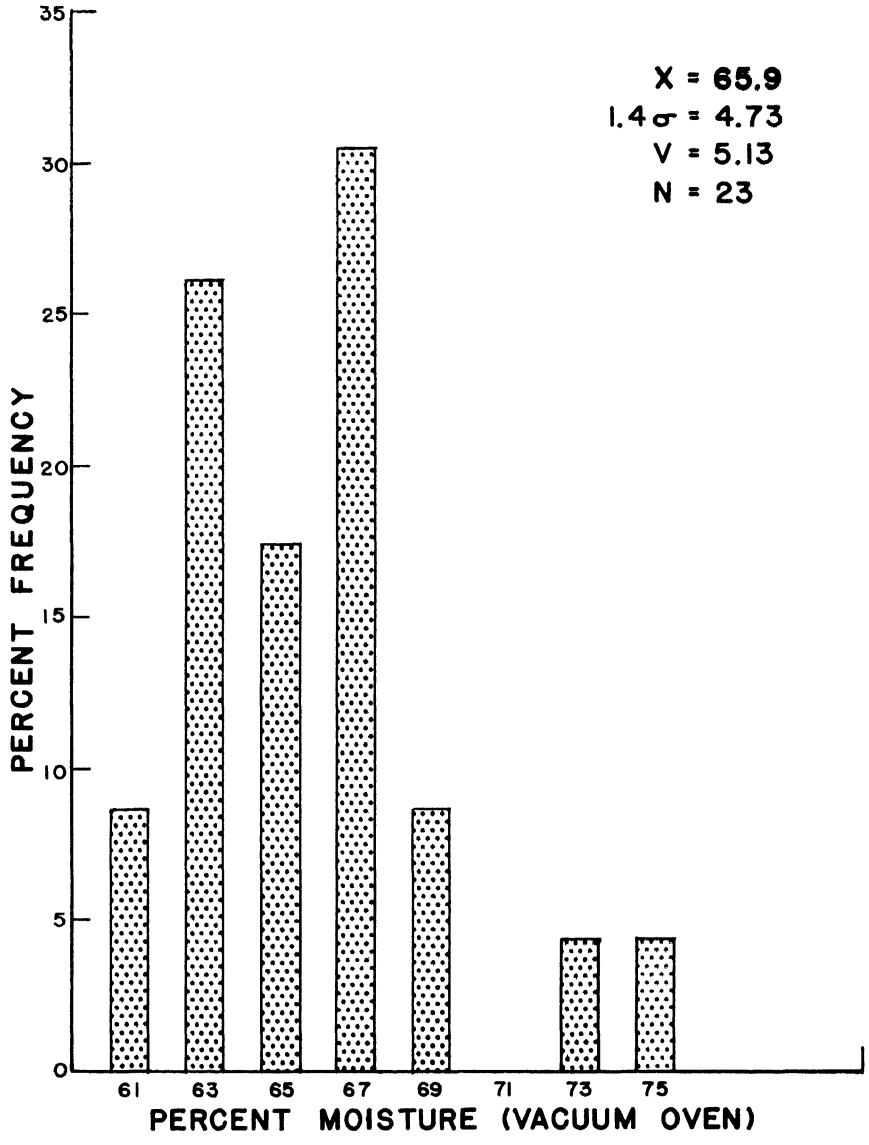


Chart 4.—Frequency distribution of moisture values (vacuum oven) of Class B Victory Golden sampled after the cutting operation 1953, 1954 and 1955.

In section E of the bulletin, other aspects of moisture will be discussed as they relate to objective definitions for maturity classifications and their relationship to the quality of the finished product.

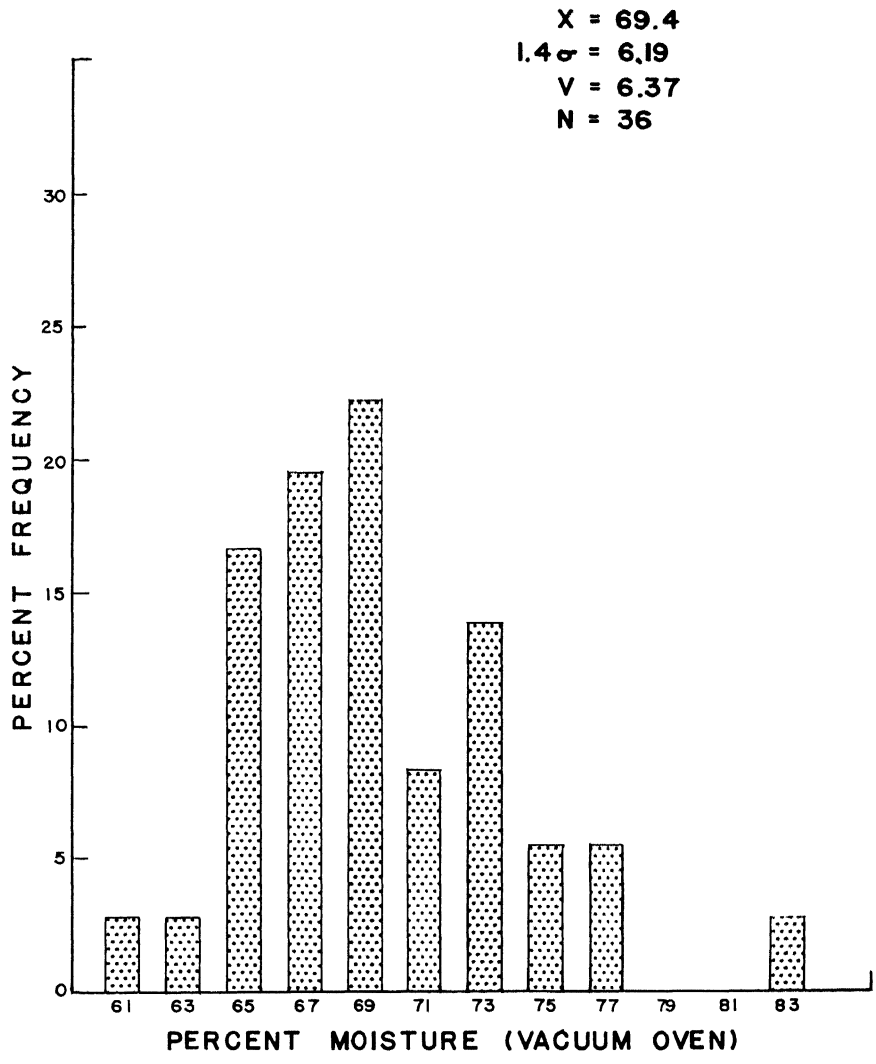


Chart 5.—Frequency distribution of moisture values (vacuum oven) of Class A Tendermost sampled after the cutting operation 1953, 1954 and 1955.

The data for two other objective measures of corn maturity are presented as frequency distribution in Charts 7 through 10. The A. I. S. and Succulence data show similar trends as found for the moisture values. For the A. I. S. values, a normal distribution of the data

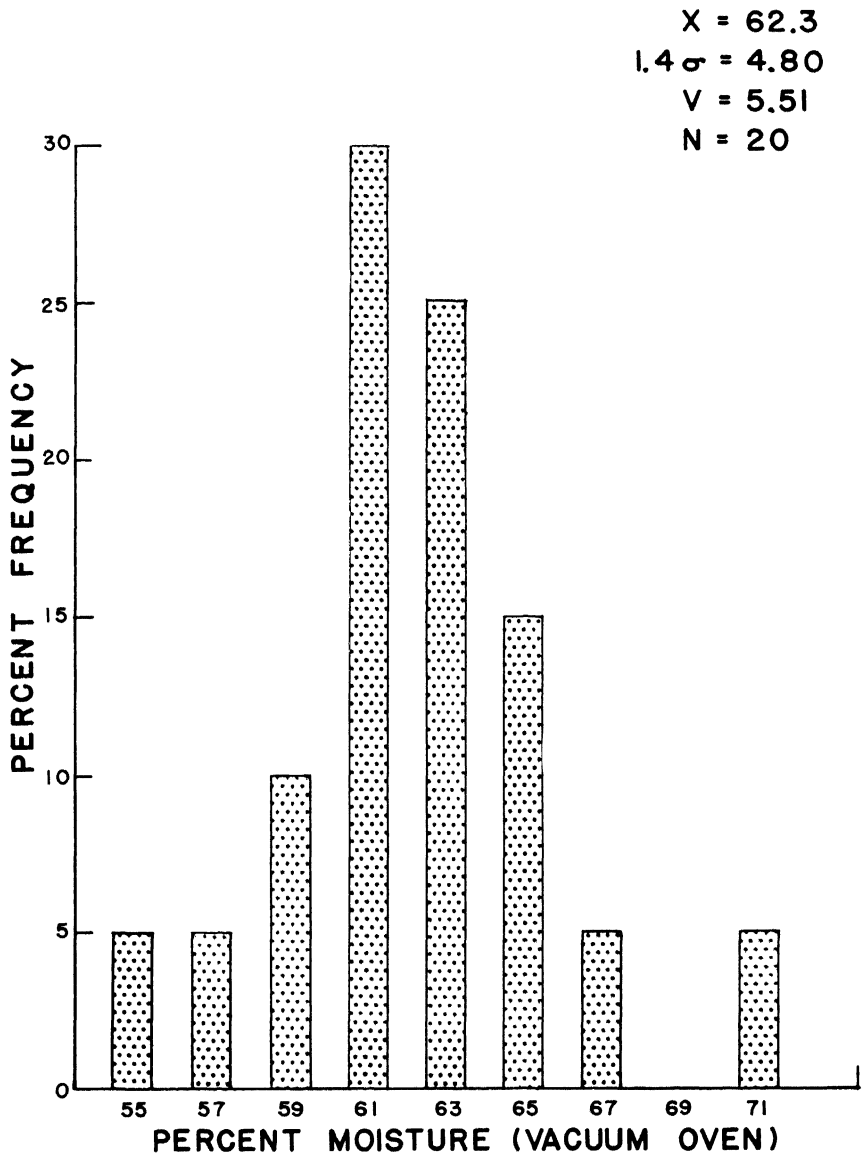


Chart 6.—Frequency distribution of moisture values (vacuum oven) of Class B Tendermost sampled after the cutting operation 1953, 1954 and 1955.

with a somewhat clearer maturity classline is defined (Charts 7 and 8). However, with the Succulometer the lower limits of Class A maturity are almost equal to the average value for the Class B maturity, or vice versa for the upper limits of Class B which is more nearly equal to the mean value of Class A maturity (Charts 9 and 10).

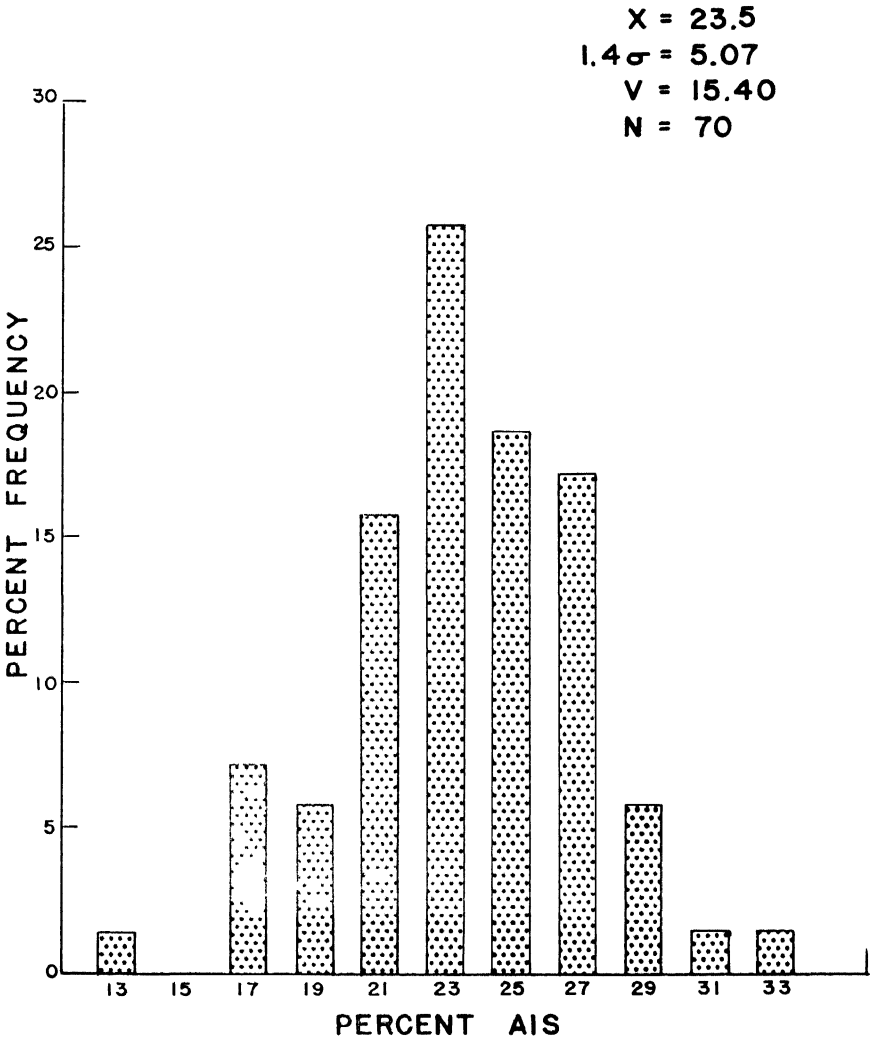


Chart 7.—Frequency distribution of AIS values of Class A Tendermost and Victory Golden sampled after the cutting operation 1953, 1954 and 1955.

It would appear from these objective data for determination of the raw grade, that the dividing lines for grades should be made more accurately than is done presently by the raw products inspector's subjective testing. Each of these objective values indicates a fairly wide

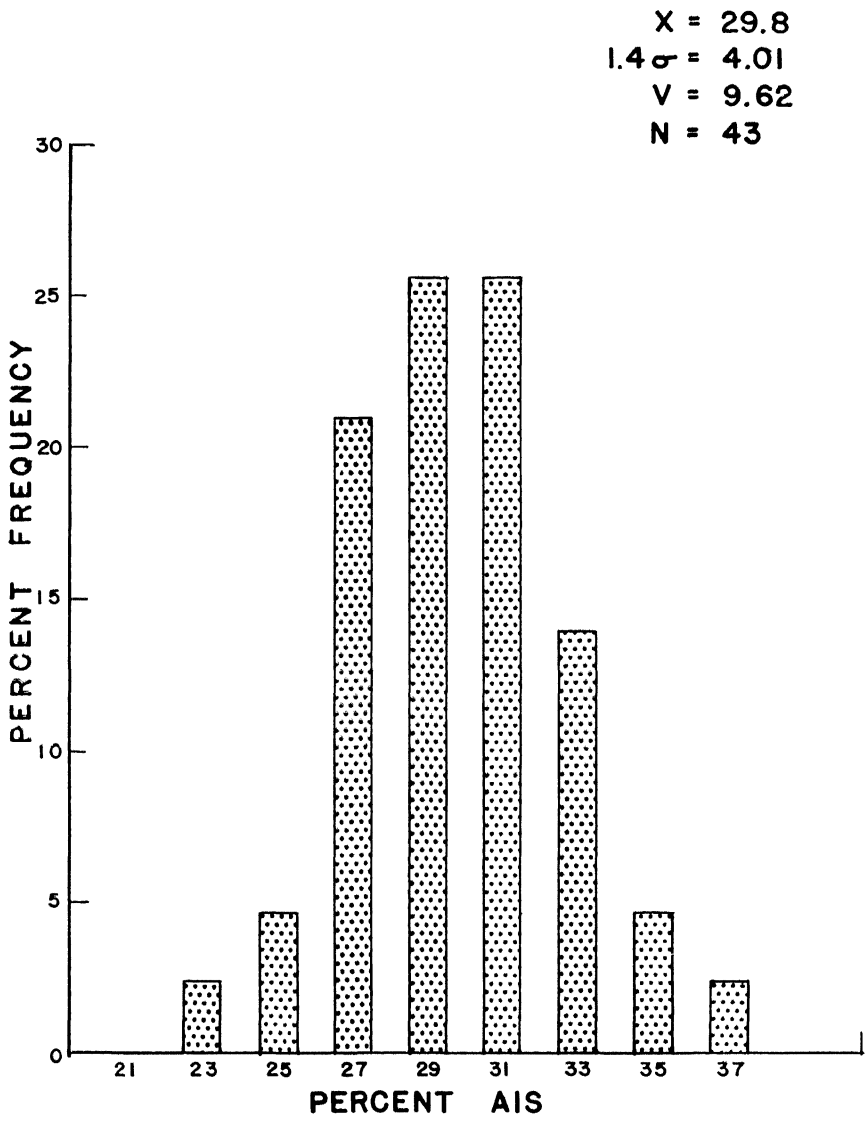


Chart 8.—Frequency distribution of AIS values of Class B Tendermost and Victory Golden sampled after the cutting operation 1953, 1954 and 1955.

dispersion of these data around the average values, thus substantiating the fact that the raw products inspector needs a more precise method of determining exact maturity class levels. In Part E of this bulletin these points will be further illustrated.

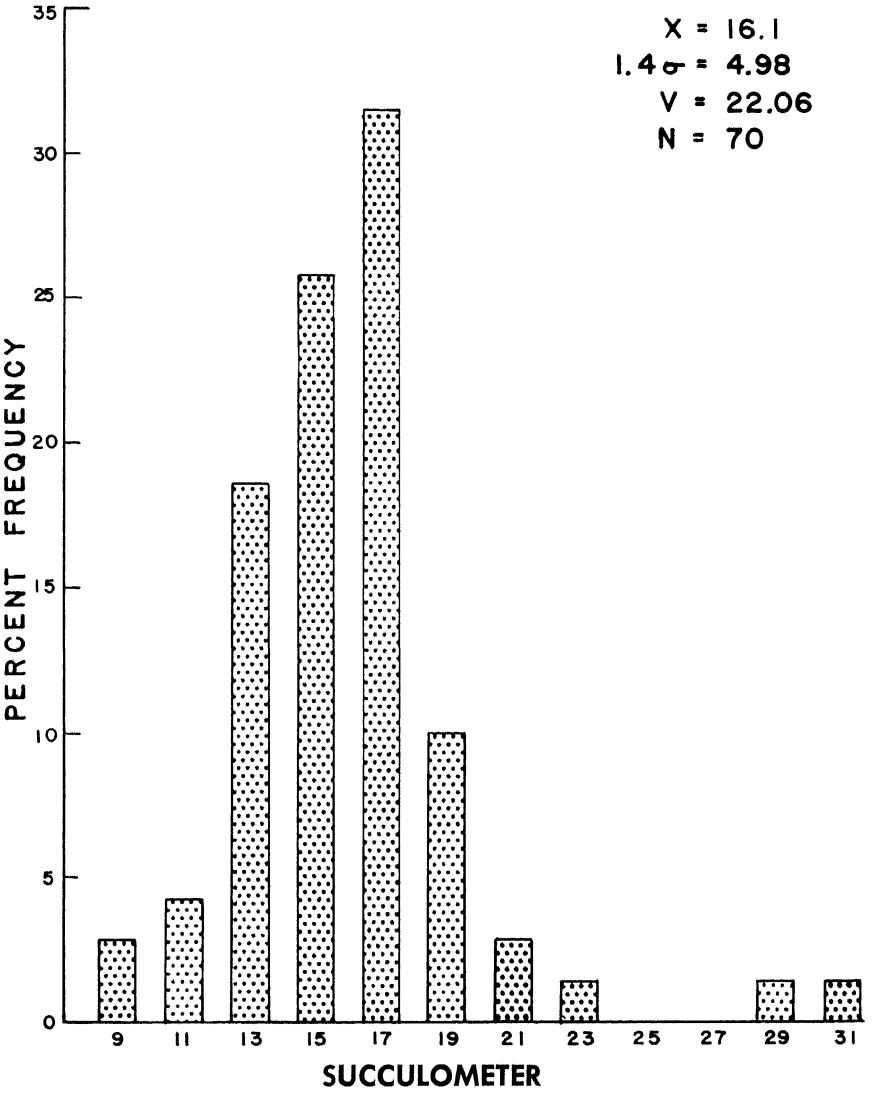


Chart 9.—Frequency distribution of succulometer values of Class A Tendermost and Victory Golden sampled after the cutting operation 1953, 1954 and 1955.

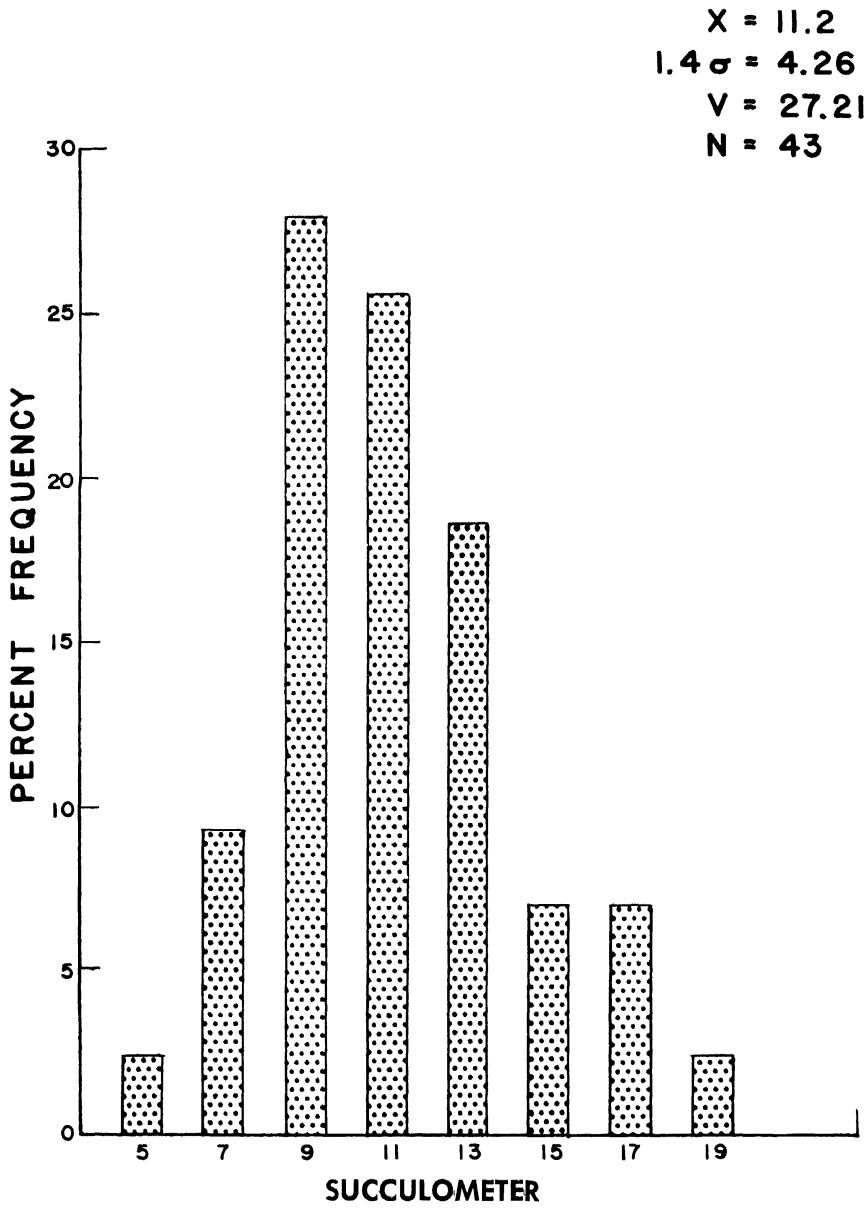


Chart 10.—Frequency distribution of succulometer values of Class B Tendermost and Victory Golden sampled after the cutting operation 1953, 1954 and 1955.

C. Relationship between finished product grades (USDA Tenderness and Maturity Factor) and specific objective methods of determining the maturity of canned and frozen whole kernel corn.

This phase of this presentation of results evaluates the relationship between subjective Tenderness and Maturity scores and a specific objective method (A. I. S.) of determining the maturity of canned and frozen whole kernel corn. This method of analyzing these data was used in an attempt to show the distribution of the A. I. S. values for the grades (Tenderness and Maturity Scores) of canned and frozen corn. The detailed data for each factor of grade are presented in Appendix Table I; however, Charts 11 through 14 depict the trends. The same problem with the evaluation of the finished product grade exists as with the determination of the raw product maturity class. Specifically, the data indicate a wide dispersion for the A. I. S. values of each grade of corn for both the canned and frozen products. The average values indicate that a line might be established; however, the spread of the data is so great that no detailed limits can be established to show a good relationship between the grade as determined by the U. S. D. A. inspector and the A. I. S. values. This again emphasizes the need for more exact methods of determining the Tenderness and Maturity factor of the finished product grade.

D. Relationship between finished grade of canned and frozen corn and specific objective tests of raw corn maturity.

The data presented in this section depict the relationship between finished grade of canned and frozen corn and specific objective tests of maturity of the raw corn. This is an attempt to determine if the limits of the grades for the raw corn can be established more precisely by working from the finished product grade back to the raw product objective maturity values. These tests of corn maturity are compared for each grade of the canned and frozen product.

The data in Table 7 clearly show a specific set of requirements in the raw corn necessary for any equivalent average finished product grade. However, again the dispersion of the data about the mean is so great that considerable overlapping of the maturity levels exist. In other words, no specific "cut-off" or boundary lines for each grade requirement can be established. On the other hand, there is a somewhat better relationship here than was found when starting with the raw class of corn maturity as determined by the raw products inspector.

TABLE 7.—Comparison of specific objective maturity values of raw corn classified according to U. S. Tenderness and Maturity scores (Grades) of canned and frozen corn, average values for two varieties and three years. (1953, 1954 and 1955)*

Objective measure of raw corn	Grade	Product	Number (N)	Mean X	Lower limits X—1.4δ	Upper limits X+1.4δ	Coefficient of variability V(%)
Moisture	A	Canned	37	71.16	67.34	74.98	3.83
		Frozen	57	69.77	65.20	74.34	4.68
	B	Canned	35	67.57	62.07	73.07	5.81
		Frozen	22	66.09	63.64	69.54	3.73
	C	Canned	15	65.30	62.26	68.34	3.32
		Frozen	6	62.30	60.98	63.62	1.51
AIS	A	Canned	37	22.50	18.01	26.99	14.24
		Frozen	57	23.98	18.89	29.07	15.15
	B	Canned	35	26.43	22.38	30.48	10.93
		Frozen	22	27.64	25.09	30.23	6.70
	C	Canned	15	29.00	26.30	31.70	6.66
		Frozen	6	31.30	30.25	32.35	2.40
Succulence	A	Canned	37	17.00	12.54	21 46	18.75
		Frozen	57	15.77	11.49	20 05	19.40
	B	Canned	35	14.48	9.33	19.63	24.43
		Frozen	22	13.91	10.90	16.91	15.45
	C	Canned	15	12.30	7.54	17.06	27.64
		Frozen	6	8.70	6.78	10.62	15.74

*No Grade C frozen values for the year 1955.

These data clearly indicate that the requirements for the finished product grade are more exacting than the raw products inspector classification would indicate. This is true for each of these 3 measurements of quality. It is interesting to note, however, that the finished product inspector has 2 sets of standards for each of the two processed products in terms of the raw grade if using A. I. S. as a standard of measurement. That is: A. I. S. canned Grade A equals an average of 22.50 while that for frozen is 23.98; the value for Grade B equals 26.43 for canned product while that of the frozen product equals 27.64. Of course, the average values are only a partial explanation. The dispersion of the data for each of these measures of quality indicates a definite need for more precise means of determining the raw product

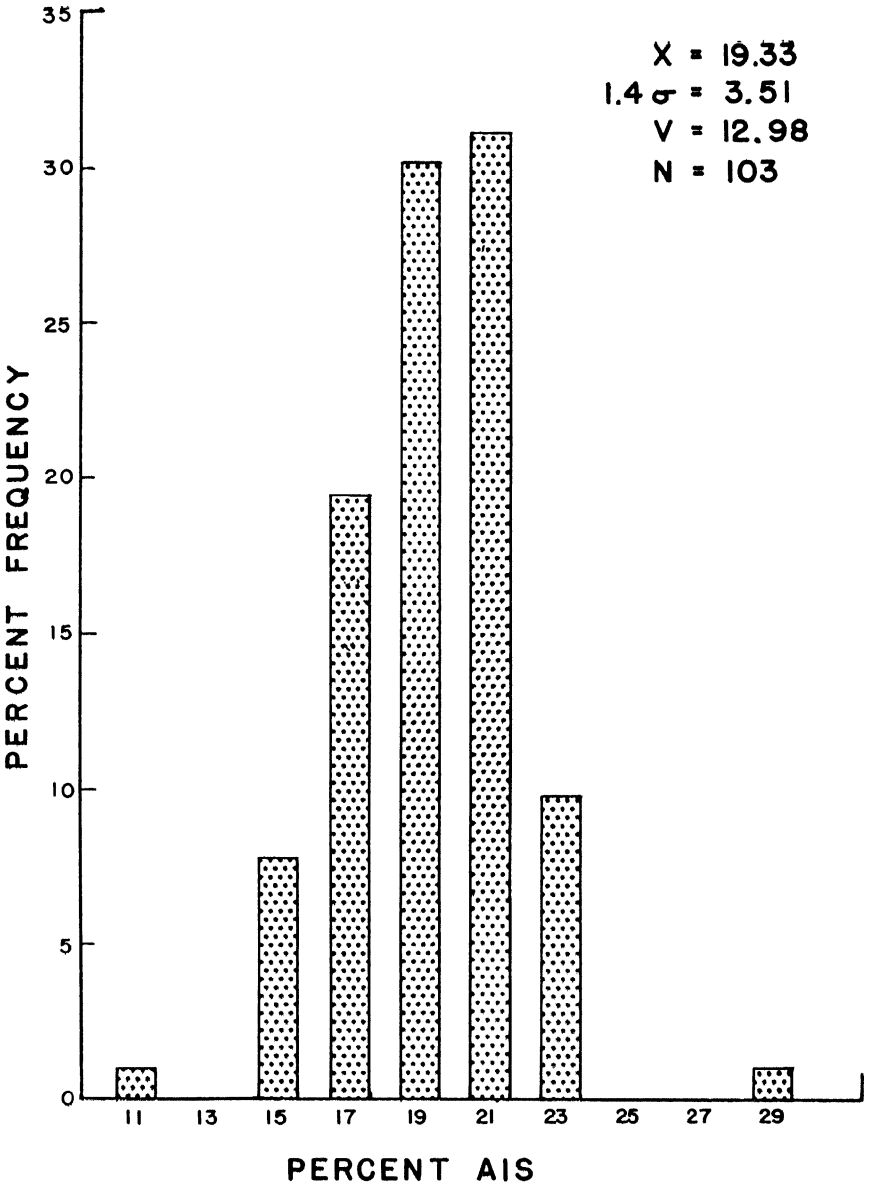


Chart 11.—Frequency distribution of AIS values of canned samples (average of both Tendermost and Victory Golden) evaluated as U. S. Grade A 1953, 1954 and 1955.

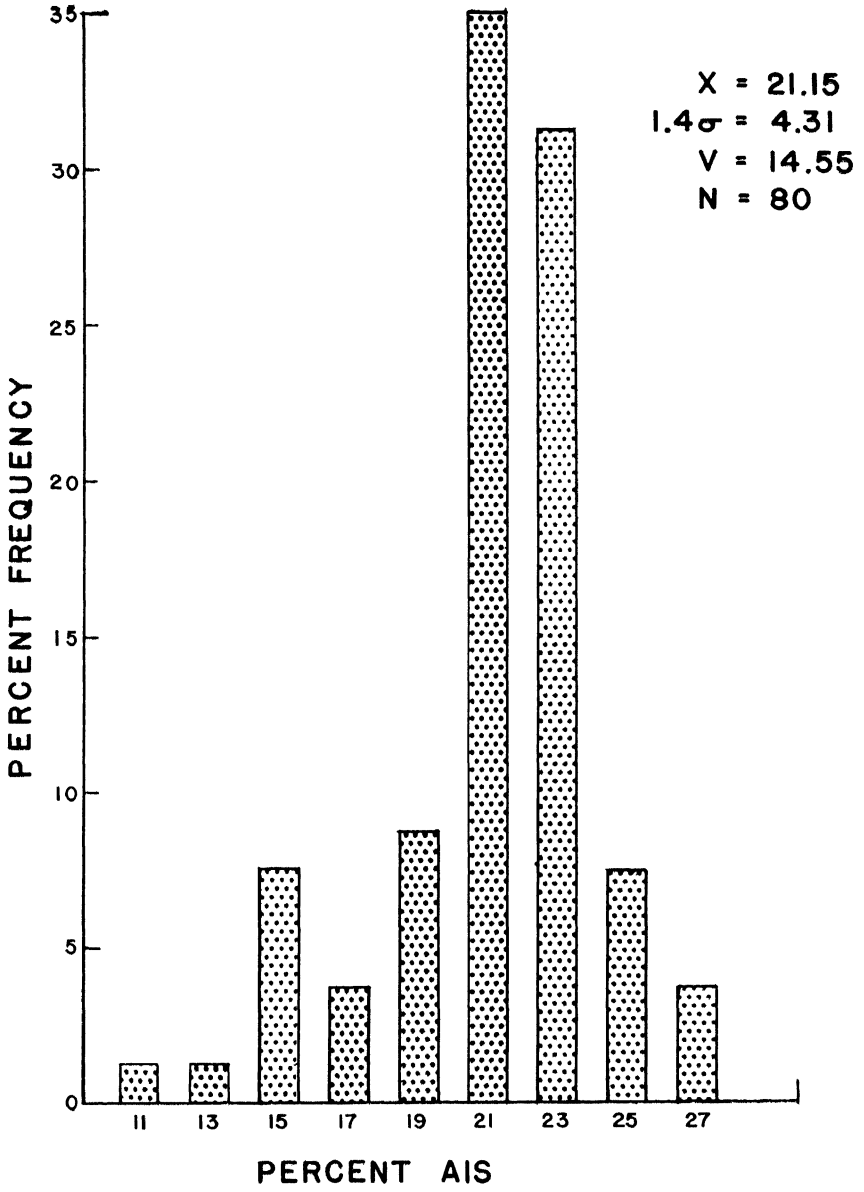


Chart 12.—Frequency distribution of AIS values of canned corn samples (average of both Tendermost and Victory Golden) evaluated as U. S. Grade B 1953, 1954 and 1955.

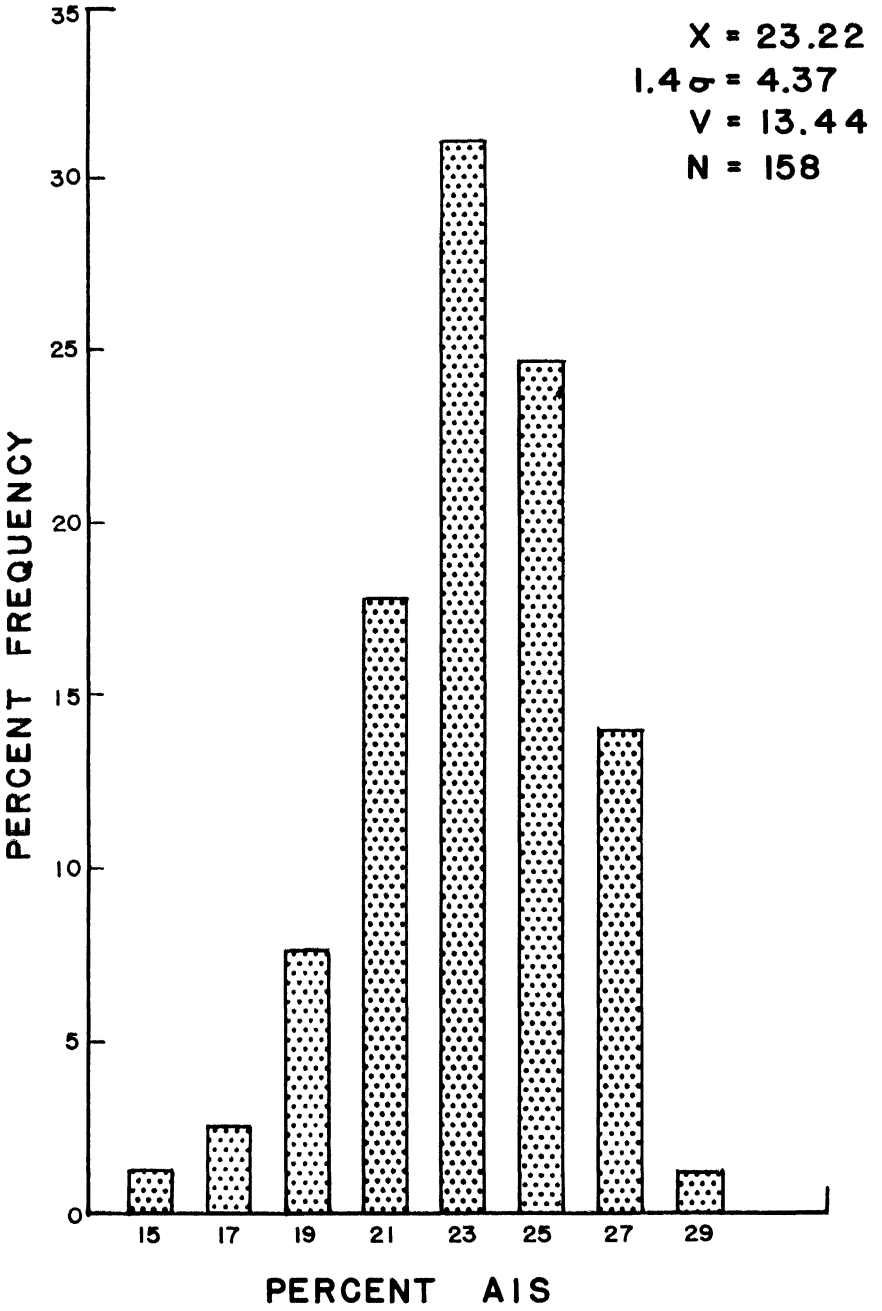


Chart 13.—Frequency distribution of AIS values of frozen corn samples (average of both Tendermost and Victory Golden) evaluated as U. S. Grade A 1953, 1954 and 1955.

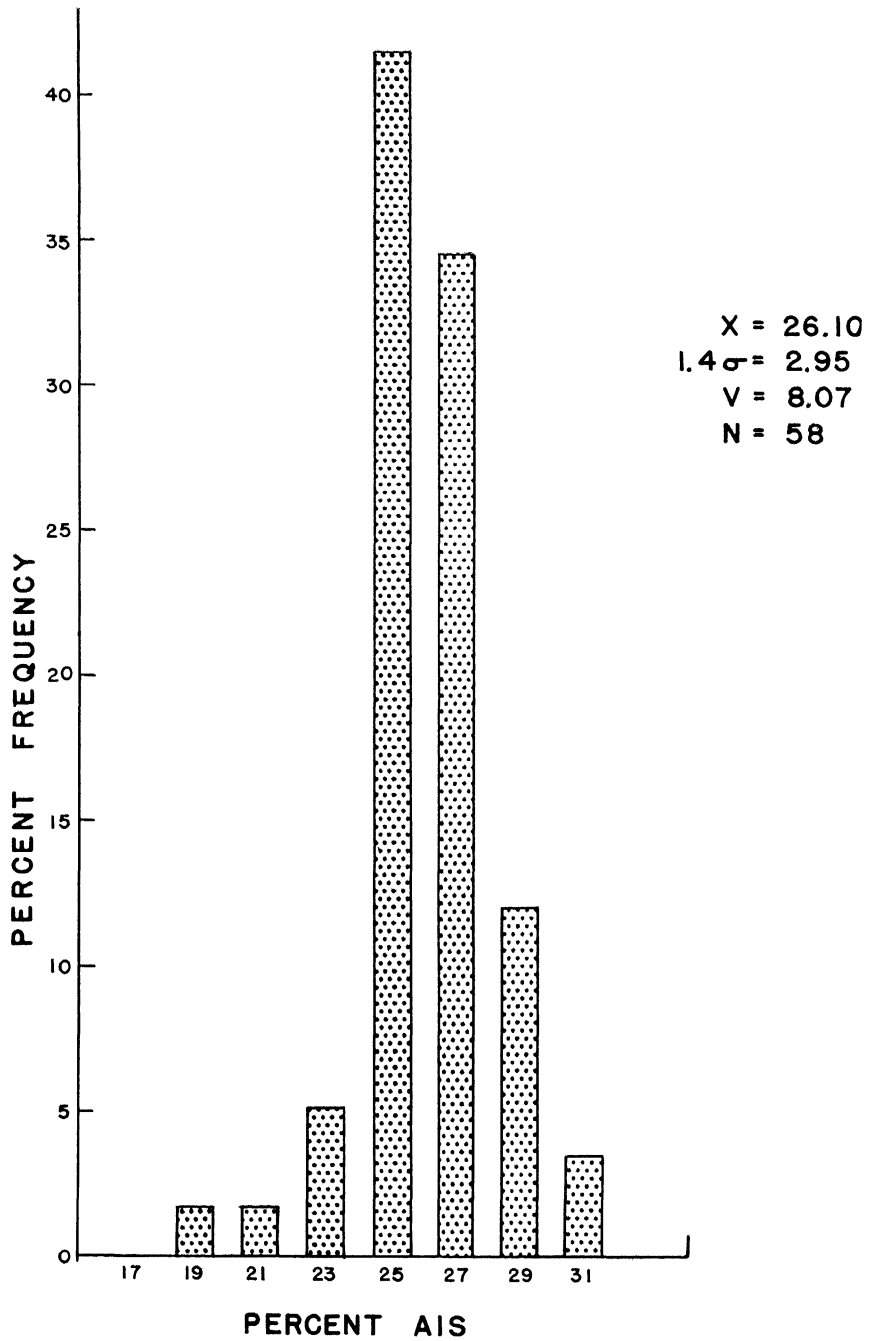


Chart 14.—Frequency distribution of AIS values of frozen corn samples (average of both Tendermost and Victory Golden) evaluated as U. S. Grade B 1953, 1954 and 1955.

classes or processed product grades. As will be shown later, this difference may not be due to the inspectors inability to evaluate these two processed products the same in terms of A. I. S., but rather the difference may be explained by the method of processing corn, that is, canned versus frozen whole kernel corn.

The low coefficient of variability for the objective measure, **moisture content,** clearly indicates that the subjective evaluation by the processed products inspector is influenced largely by the moisture present in the processed product. However, as stated before, the inspector appears to have different standards for the frozen product; but he still seems to rely on moisture content, although, at a lower level.

E. Relationship between objective measurements of quality between raw and processed products and the effect of specific processing variables on quality retention.

The data in this section are presented for each objective attribute of quality (A. I. S., Pericarp, Soluble Solids, Moisture, and Succulometer) by considering:

(1) Raw maturity classification (Class A, B, & C)

(2) Variety—Tendermost and Victory—Average values regardless of maturity classification.

(3) Seasons—1953, 1954, and 1955—regardless of variety or maturity classification. Further, these data are presented in chart form to illustrate the effect of sampling points (locations of taking samples during processing and the difference between the 2 processed products.)

The interpretation of the data in this section of the bulletin illustrates many of the problems concerned with grade relationships, objective tests for corn quality, and the 3 variables (1) raw product maturity classifications, (2) varieties and (3) seasonal effects.

1.—Soluble Solids

In studying the soluble solids data, Chart 16, it is quite evident that some differences due to maturity classification are observed, also some differences are noted between the two varieties and the seasonal effects. However, it is quite evident that this method of objectively determining corn maturity is not as reliable as some of the other methods.

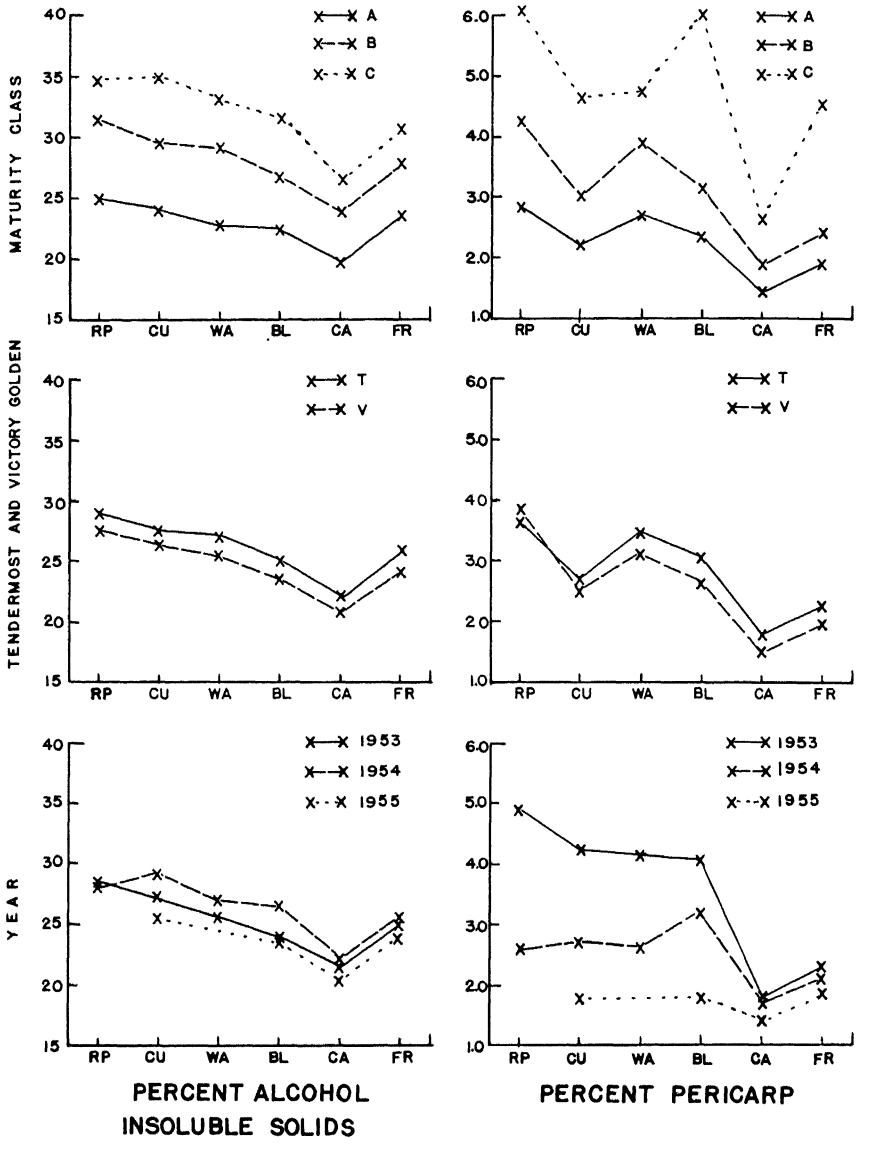


Chart 15.—Effect of stages of processing (RP-raw product CU-cutter, WA-washer, BL-blancher, CA-canned, and FR-frozen) on quality of sweet corn by Maturity Class, (A, B and C), Variety (T-Tendermost and V-Victory Golden) and Year (1953, 1954 and 1955) for percent AIS and percent pericarp.

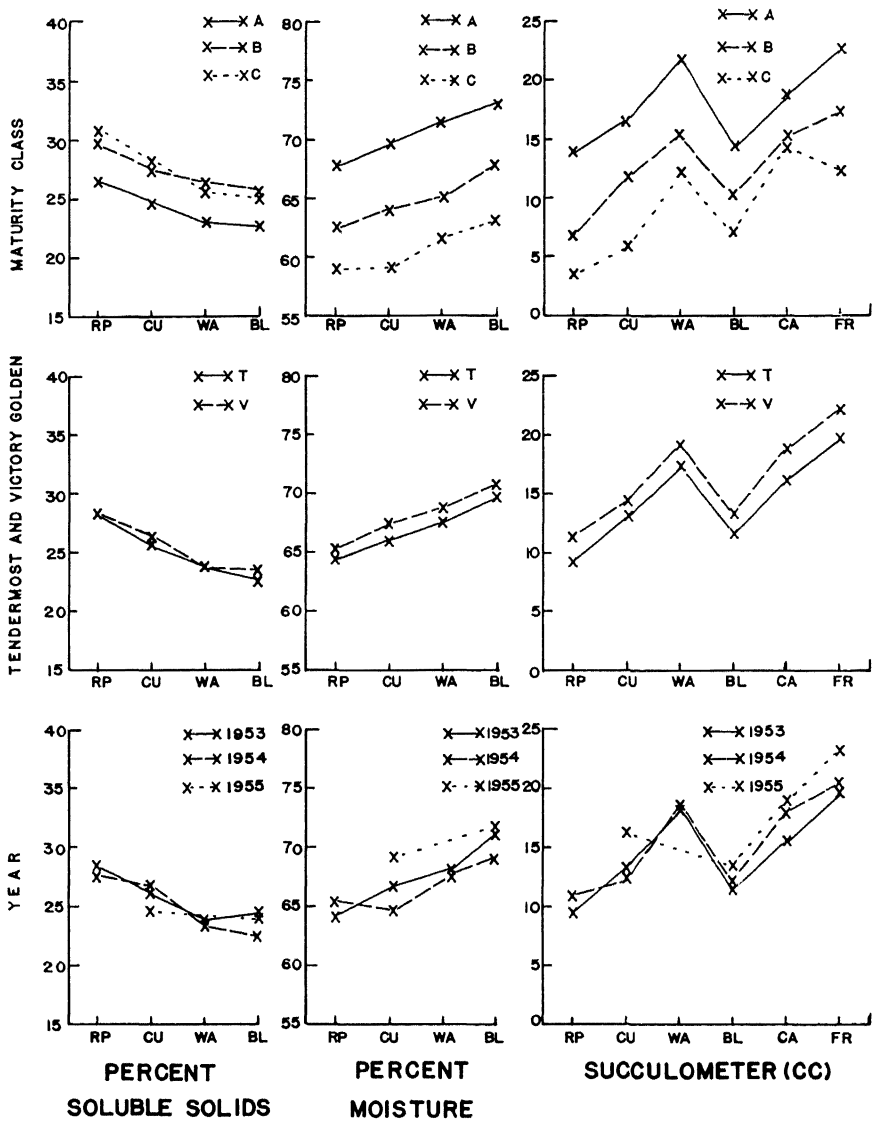


Chart 16.—Effect of stages of processing (RP-raw product, CU-cutter, WA-washer, BL-blancher) on quality of sweet corn by Maturity Class, (A, B and C), Variety (T-Tendermost and V-Victory Golden) and Year (1953, 1954 and 1955) for percent soluble solids, percent moisture, and succulence (Succulometer-cc).

2.—Moisture

Excellent relationships between the maturity classes are noted for the moisture values. Further, sampling at any one of the 4 sample points (raw product, cutter, washer, and blancher) would appear to be adequate. However, it should be noted from the data in Chart 16, that the sampling points may be as important as the differences noted for each maturity class. When the 2 varieties were compared, Victory Golden had approximately 2 percent more moisture than Tendermost at each of the sampling points. The average seasonal effects were quite variable. The values obtained in 1953 were in between those obtained in 1954 and 1955. When the samples taken at the cutter were compared, 5 percent variation between the 3 years was noted.

3.—Succulometer

The values obtained from the Succulometer are similar to those reported above for percent moisture, (Chart 16). However, the step in the process where the sample is taken is very important. The highest values were obtained from samples taken at the washer and the lowest in the raw product or blancher samples. A good differentiation was noted between maturity classes, as well as variety and seasonal effects. These parallel the same as noted for the moisture values. It should be pointed out that considerable differences are noted between the canned and frozen samples, with the frozen values, on an average, somewhat higher than those from equivalent qualities of canned samples.

4.—Alcohol Insoluble Solids

The A. I. S. values are similar to those obtained for percent moisture, Chart 15. The differences noted for sampling points are not nearly as great as noted for Succulometer or percent moisture. Distinguishable differences are noted for maturity classification with average values as great as 10 percent between low values (25 percent—Class A) to the high values (35 percent—Class C) in the raw product. The differences are not as great in the processed product; however, the frozen samples had approximately 3 percent higher values than the canned samples. The difference for Class A to C maturities between the canned samples (7 percent) and the frozen sample (7 percent) are not as great as for the raw product. The varietal effect shows the Tendermost variety to have an average value of approximately 2 percent higher A. I. S. than Victory Golden.

The seasonal effects are comparable to those indicated by the percent-moisture values. That is, the 1953 values were between those obtained for the 1954 and 1955 seasons. The differences were approximately the same as for percent moisture.

5.—**Pericarp**

Wide variations existed for pericarp values for maturity classifications and seasonal variations, Chart 15. Further, distinct differences existed between Tendermost and Victory Golden.

The extreme difference between values for years, at the unprocessed sample points are attributed somewhat to techniques of sample comminuting and preparation. It should be noted the values for the first 2 years were somewhat higher than the processed samples. However, no great differences were encountered in the processed samples for the 3 years.

The same differences were noted between the maturity classes as noted for the other objective methods of evaluating maturity. That is, the more mature the corn, the greater the amount of pericarp. Also, the Tendermost variety had higher pericarp values than were found for the Victory Golden variety.

F. **Relationship between raw maturity classification and percent cut-off (yield).**

1. Variety effect.

Percent cut-off by variety is summarized in Table 8. For all raw product classification, the Tendermost variety gave the higher percent cut-off, and difference between the varieties increased as the raw product maturity increased. However, the gross unhusked yields were considerably higher with the Victory Golden variety (Appendix Tables D, E, & F). Also, the variety Victory Golden gave the higher quality canned product and slightly better frozen product for the same raw product classification as the Tendermost variety.

It would appear that the variety Victory Golden would be the more suitable of the 2 varieties for a packer of quality canned and frozen whole kernel corn.

2. Seasonal effect by variety.

For the raw product classification A of the variety Tendermost, the 1953 and 1955 seasons' percents cut-off were approximately 4.4 and 3.5, respectively higher than the cut-off for the 1954 season. However, the percents cut-off for Class A corn of the Victory Golden variety were approximately the same for the 3 seasons, and this

was also true for the raw product B classification. But, the percent cut-off for Class B Tendermost variety was quite variable for the 3 seasons, with the 1955 season being the lowest and approximately the same as for the percent cut-off of the Class A maturity. The percent cut-off of the Class C maturity was variable for both varieties during the 1953 and 1954 seasons, while in 1955 no Class C maturity corn was cut as whole kernel corn. These cut-offs are unimportant for whole kernel corn, since all processed whole kernel corn of Class C graded Substandard. These above data are presented in Table 8.

3. Seasonal effect combining the two varieties.

These data are also summarized in Table 8. The percent cut-off for the Class A maturity was approximately the same for the 1953 and 1955 seasons, and the average percent cut-off was approximately 2 percent less for the 1954 season. There appears to be no trend exhibited by the maturity class since for Class B maturities the percent cut-off for the 1955 season varied and was less than those from the 1953 and 1954 seasons. The average percent cut-off for Class C maturity corn was approximately the same for the 2 seasons, 1953 and 1954.

TABLE 8.—Summary table for percent cut-off* of Class A, B and C Tendermost and Victory Golden for the years 1953, 1954 and 1955†

Variety	Year	Class A Percent Cut-off	Class B Percent Cut-off	Class C Percent Cut-off
Tendermost	1953	33 8	41.5	44.0
	1954	29 4	39.6	38 0
	1955	32.9	32.8	----
	Average	32.1	38.9	42.0
Victory Golden	1953	27.2	31.4	29.4
	1954	27.1	31.0	32 3
	1955	27.5	30.2	----
	Average	27.3	31.0	30 5
Variety Averages	1953	30.4	36.4	33.6
	1954	28.4	35.3	33.8
	1955	30.6	31.3	----
Grand Average		29.8	34.8	33.6

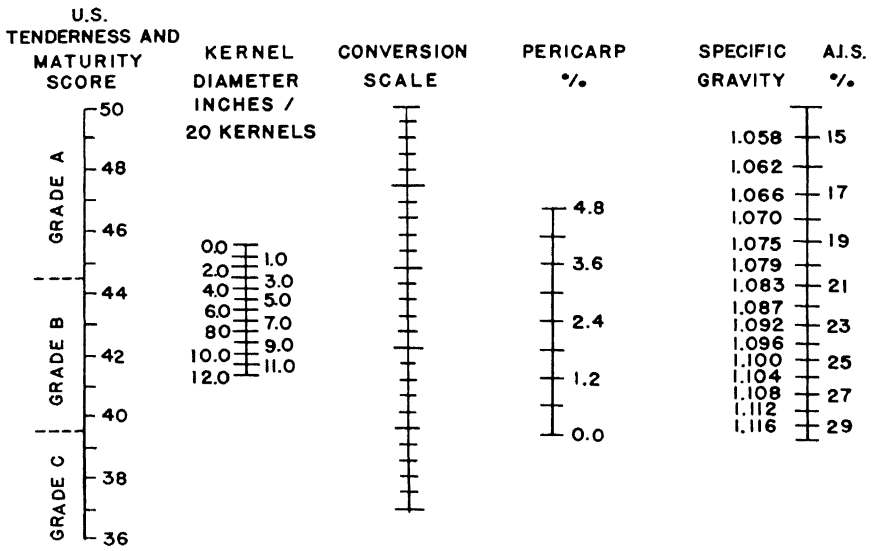
*Percent cut-off figured on basis of unhusked corn.

†Detailed data in Appendix.

G. **Specific gravity: a method for the evaluation of raw, canned and frozen whole kernel corn maturity.**

The specific-gravity principle was applied by weighing a corn sample in air and then weighing it in a liquid (water) of known specific gravity. This was first used on 1954 season's processed canned and frozen samples. When the 100 gram specific-gravity values of the processed samples were compared with A. I. S. of canned and frozen Tendermost and Victory Golden whole kernel corn samples, correlation coefficients of 0.958 and 0.719, respectively, were obtained.

During the 1955 season the 6 pound and 100 gram techniques were compared with moisture and A. I. S. values, obtained at the raw cut and blanched sample points, the relationships at the raw cut corn sample point were found to be slightly better. Correlation coefficients of 0.926 and 0.887 between specific gravity and A. I. S. of canned and frozen whole kernel corn, respectively, indicated a high relationship of



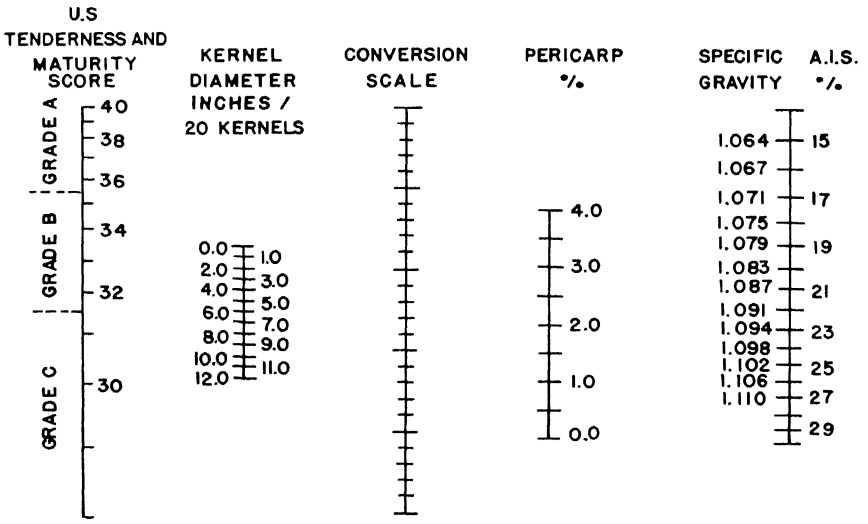
From selected points on specific-gravity or A.I.S. and pericarp scales, extend line until it intersects conversion scale. From this intersection point extend line through selected point on kernel diameter scale to tenderness and maturity score scale. This point is the numerical tenderness and maturity score.

***Basic Nomograph Taken From Twigg Et al.**

Chart 17.—Modified nomograph for determining U. S. Grade for tenderness and maturity of canned sweet corn from determination of specific gravity or AIS, pericarp and kernel size.*

the 1955 processed corn. Highly significant correlation coefficients indicated that specific-gravity values of the fresh cut corn could be used to predict the specific gravity of the processed canned or frozen whole kernel corn.

In order to further evaluate the specific-gravity techniques, fresh and processed samples of varieties not concerned with this study were analyzed. When the processed whole kernel corn data were combined with values obtained in this study, specific-gravity values were related to processed product A. I. S. content to the extent that the quick specific-gravity method could replace the time consuming A. I. S. determination (13). This appeared to be especially applicable to nomographs prepared by Twigg et. al. (29) for determining U. S. Grades in terms of the Tenderness and Maturity factors of canned and frozen whole kernel sweet corn. Nomographs with specific-gravity values introduced there on as an alternative for the alcohol solids determination, are presented in Charts 17 and 18.



From selected points on specific-gravity or A.I.S. and pericarp scales, extend line until it intersects conversion scale. From this intersection point extend line through selected point on kernel diameter scale to tenderness and maturity score scale. This point is the numerical tenderness and maturity score.

***Basic Nomograph Taken From Twig Et al.**

Chart 18.—Modified nomograph for determining U. S. Grade for tenderness and maturity of frozen sweet corn from determination of specific gravity or AIS, pericarp and kernel size.*

In order to establish U. S. canned and frozen grade limits for specific-gravity values, all graded processed Tendermost and Victory Golden samples were classified according to the U. S. D. A. processed product's inspector's grade. This also included field run lots which were not given a raw product classification and so are not included in data presented in Appendix Table O and P. By means of this classification specific-gravity limits for U. S. Grades were calculated and are presented in Tables 10 and11 of the General Discussion. The method of calculation was the same as that used for calculating grade limits for the other objective tests. The specific-gravity grade limits for the raw product were determined by including data from additional varieties to make the values more representative, and this was accomplished by means of regression charts (Charts 7 and 8 of cited reference 13).

GENERAL DISCUSSION

There appeared to be a direct relationship between raw and finished grades when they were evaluated subjectively, but the grades were displaced and the relationship was affected by variety and seasonal conditions. For the same raw product quality, as determined subjectively, the variety Victory Golden consistently was given the higher U. S. D. A. grade or higher total score points for U. S. D. A. grades of canned and frozen whole kernel corn than was corn processed from the variety Tendermost. This was true for the three seasons, although, the same subjective raw product class of either the variety Victory Golden or Tendermost did not produce the same processed product grade from season to season. On an average the use of Class A raw corn resulted in Grade B canned corn. Class B resulted in Grade C, and Class C in Grade D or Substandard canned corn. However, on an average with frozen corn Grade A frozen corn was secured from Class A raw corn, Grade C from Class B and Grade D or Substandard frozen whole kernel corn from Class C raw corn.

The raw products inspector appeared to base his judgment of what constituted the various raw product classes by the moisture content. This would seem logical since the inspector's primary means of determining the raw-product classification with reference to the degree of maturity of the ears of corn is by the thumb nail test. With the two varieties used in this study, the inspector appeared to use a different moisture level for each variety and his moisture level requirement for the same classification appeared to decrease as the season progressed. This indicates that even though the raw products inspector can establish classification limits, these limits vary with varieties and within the same season for each variety.

Table 9 summarizes the variability of the processed products inspector from cutting to cutting. In the overall grading program the inspector was able to reproduce his results only 60 and 70 percent of the time. However, his repeatability appeared to be slightly better with the frozen product than with the canned whole kernel corn. The variability of grade was generally due to the Tenderness and Maturity factor. In such cases the data indicate that the inspector appeared to have in mind a slightly different concept of the degree of tenderness and maturity that belonged to the different processed grade scores, or the variation within one of the codes was great enough to cause grade variation If the Tenderness and Maturity factor was determined objectively, the inspector's interpretation of this factor would be eliminated, or he could base his judgment on the results of objective testing.

In order to eliminate variation of interpretation of the Tenderness and Maturity factor of comparable samples of fresh and processed corn, objective methods must be used. Minimum specific-gravity limits for grades in terms of the Tenderness and Maturity factor have been calculated in section G of this bulletin. These limits can also be calculated for some of the other objective methods such as A. I. S., moisture content and succulence by using the specific objective values appropriate to the finished product grade (Table 7). To make these dividing lines more realistic, the calculations were made from polled data of both varieties. Calculated grade limits based on the U. S. Tenderness and Maturity scores from U. S. Standards for Grades of Canned and Frozen Whole Kernel Corn are presented in Tables 10 and 11 respectively. The method used to calculate the dividing lines between the A and B, and B and C, U. S. grades is as follows: (The mean of Grade A + the standard deviation of Grade A) — the mean of Grade B + the standard deviation of Grade B) is divided by two. The result of the calculation is then subtracted from the mean of Grade A + the standard deviation of Grade A which equals the A. I. S. value which would be the dividing line between U. S. Grade A and U. S. Grade B according to the U. S. Tenderness and Maturity factor. The dividing line between Grade C and substandard corn was determined by adding the standard deviation to the mean (A. I. S. and specific-gravity) or subtracting the standard deviation from the mean (moisture and succulence).

Although a direct relationship was found between the raw product classifications and finished product grades, it appears more desirable to base the minimum limits of the several objective tests for grades on the finished product grade rather than the raw product grade. However, these limits would apply only to processing techniques which are similar to those used in this study.

TABLE 9.—Variation of grades designated at different cutting by U. S. D. A. Processed Products Inspectors to the same codes (samples) of canned and frozen whole kernel corn

Commodity	Year	No. of samples	Cuttings*								
			Percent up			Percent same			Percent down		
			1vs2	2vs3	1vs3	1vs2	2vs3	1vs3	1vs2	2vs3	1vs3
Canned	53	78	11.8(5)†	0.0	0.0	73.5(25)	40.9(9)	50.0(11)	14.7(4)	59.1(13)	50.0(11)
	54	176	11.9(7)	28.8(17)	19.0(11)	54.2(32)	67.8(40)	63.8(37)	33.9(20)	3.4(2)	17.2(10)
	55	39	10.2(4)	-------	-------	84.6(33)	--------	--------	5.1(2)	-------	-------
Average		293	12.1(16)	13.8(17)	68.2(11)	68.2(90)	60.5(49)	60.0(48)	19.7(26)	18.5(15)	26.2(21)
Frozen	53	89	19.3(6)	20.7(6)	31.1(9)	71.0(22)	72.4(21)	65.5(19)	9.7(3)	6.9(2)	3.4(1)
	54	159	11.3(6)	1.9(1)	0.0	77.4(41)	56.6(30)	64.2(34)	11.3(6)	41.5(22)	35.8(19)
	55	35	31.4(11)	-------	-------	68.6(24)	--------	--------	0.0	-------	-------
Average		283	19.3(23)	8.5(7)	11.0(9)	73.1(87)	62.2(51)	64.6(53)	7.6(9)	29.3(24)	24.4(20)
Average for 3 years		576	15.5(39)	14.7(24)	12.4(20)	70.5(177)	61.4(100)	62.3(101)	14.0(35)	23.9(39)	25.3(41)

*Cuttings: First—2 months after processing, Second—6 months after processing, and Third—14 months after processing.

†Numbers in parentheses are actual numbers of samples which scored up, down, or same.

TABLE 10.—Suggested limits for U. S. Grades of Canned Whole Kernel Corn in terms of values obtained from objective tests arranged according to U. S. Tenderness and Maturity scores (1953, 1954 and 1955)

Objective Tests	**Minimum – ***Maximum Limits for Grades		
	A	B	C*
Fresh Cut Corn			
A. I. S.	24.63 ***	28.20 ***	30.93 ***
Moisture†	68.77 **	67.32 **	63.17 **
Succulence‡	15.50 **	13.50 **	8.90 **
Specific gravity (6 lb. method)§	1.096***	1.109***	1.116***
Canned Corn			
A. I. S.	20.01 ***	24.23 ***	27.00 ***
Specific gravity (100 g. method)‖	1.082**	1.092**	1.096**

*Grade C limit determined by adding or subtracting the standard deviation to the Grade C mean.

†Moisture values obtained with the vacuum oven technique.

‡Succulence as determined with the Succulometer.

§Values determined from regression Chart 7 in reference 13.

‖Values calculated from field run and maturity classified lots from 1954 and 1955 seasons.

**Minimum.

***Maximum.

With the specific gravity and preceding limits presented, a packer could evaluate his raw product objectively thus eliminating the fluctuations that appear to exist with subjective testing. The packer would be able to produce a more uniform product, or he would be relatively sure when his raw product quality was changing and could act accordingly. Proposed limits also apply to the quality of the processed product in terms of the U. S. Tenderness and Maturity factors for canned and frozen whole kernel corn.

Of the objective tests proposed for use in determining finished product quality, specific gravity appears most suitable for both fresh (6-pound method) and processed (100-gram method) product evaluations. This is proposed because of appropriateness of the sample size, inexpensive equipment requirements and short time for determination. The latter is less than 15 minutes.

TABLE 11.—Suggested limits for U. S. Grades of frozen whole kernel corn in terms of values obtained from objective tests arranged according to U. S. Tenderness and Maturity scores (1953, 1954 and 1955)

Objective Tests	**Minimum – ***Maximum Limits for Grades		
	A	B	C*
Fresh Cut Corn			
A. I. S.	26.71 ***	30.02 ***	32.05 ***
Moisture†	68.33 **	64.95 **	61.36 **
Succulence‡	15.30 **	11.70 **	7.30 **
Specific gravity (6 lb. method)§	1.106***	1.111***	1.122***
Frozen Corn			
A. I. S.	25.16 ***	28.21 ***	30.73 ***
Specific gravity (100 g. method)‖	1.100***	1.103***	1.112***

*Grade C limit determined by adding or subtracting the standard deviation to the Grade C mean.

†Moisture values obtained with the vacuum oven techniques.

‡Succulence as determined with the Succulometer.

§Values determined from regressions Chart 8 in reference 13.

‖Values calculated from field run and maturity classified lots from 1954 and 1955 seasons.

**Minimum.

***Maximum.

SUMMARY AND CONCLUSIONS

Samples of sweet corn were classified for maturity by a Federal-State fresh fruit and vegetable inspector. They were, also, evaluated by means of objective tests for quality. Furthermore, the finished product was graded by a U. S. D. A. Processed Products Inspector.

Known classifications of raw sweet corn of two varieties were canned and frozen under pilot plant conditions using acceptable commercial practices. This study was conducted during the years 1953, 1954 and 1955. The major results are summarized as follows:

1. There appeared to be a direct relationship between raw and processed grades but the grades were displaced, particularly in the case of the canned product. For example, on the average, the use of Class A raw corn resulted in Grade B canned corn, while Class B resulted in Grade C and Class C in Grade D or Substandard canned corn. The grade relationship between raw and frozen corn was more direct. These relationships, however, varied with variety and season.

2. The values obtained from the various tests showed considerable overlapping when they were arranged according to raw product class or finished product grade.

3. In order to more sharply define the finished product grade in terms of the raw or processed product, minimum limiting values on the basis of U. S. Tendermess and Maturity Factor were proposed for the objective tests; specific gravity, A. I. S., succulence, and moisture.

4. The specific-gravity techniques, 6-pound method applied to the raw product and 100-gram method applied to the processed product, are recommended as the better all around objective methods, because of sample size (raw product), simplicity of application, quick results, and relatively inexpensive equipment.

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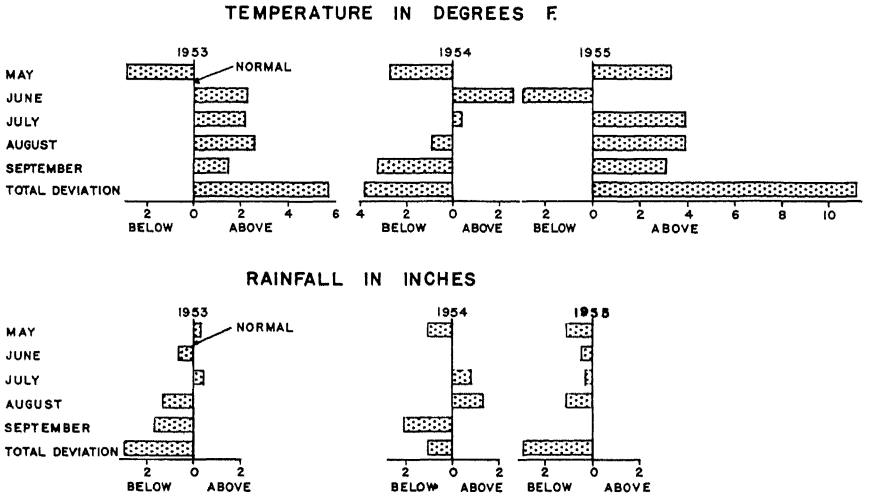
APPENDIX



Appendix Chart 1.—Climatological data—Monthly and total temperature and rainfall deviation from normal during the growing seasons for 1953, 1954 and 1955. Columbus, Ohio.

APPENDIX TABLE A.—Some Plant and Ear Characteristics of Corn During Maturation. 1953

	Observation date	Percent in tassel	No. of ears per plant	Percent green silk	Percent dry silk
TENDERMOST					
Planting					
1	7/25	100	.90	100	0
	8/1	100	.99	67	33
	8/8	100	1.5	33	67
	8/15	100	1.5	0	100
2	7/25	90	.27	100	0
	8/1	100	.64	84	16
	8/8	100	.88	65	35
	8/15	100	.85	1	99
	8/23	----	.68	0	100
3	7/25	46	.15	100	0
	8/1	95	.67	100	0
	8/6	100	1.1	92	8
	8/15	100	.86	52	48
	8/23	----	.67	6	94
4	7/25	41	.1	100	0
	8/1	95	.53	100	0
	8/8	100	1.0	90	10
	8/15	100	1.1	47	53
	8/23	----	.77	6	94
VICTORY GOLDEN					
Planting					
1	7/25	92	.94	100	0
	8/1	100	.93	39	61
	8/8	100	1.1	26	74
	8/15	100	1.2	4	96
2	7/25	85	.66	100	0
	8/1	100	.87	69	31
	8/8	100	.89	24	76
	8/15	100	1.1	2	98
	8/23	100	.75	0	100
3	7/25	19	.27	100	0
	8/1	63	.56	100	0
	8/8	98	1.1	100	0
	8/15	100	1.1	53	47
	8/23	100	.85	0	100
4	7/25	40	.43	100	0
	8/1	67	.35	100	0
	8/8	100	1.3	100	0
	8/15	100	1.2	48	52
	8/23	100	.83	0	100

APPENDIX TABLE B.—Some Plant and Ear Characteristics of Corn During Maturation. 1954

	Observation date	Percent in tassel	No. of ears per plant	Percent green silk	Percent dry silk
TENDERMOST					
Planting					
1	7/24	100	.65	100	0
	7/28	100	2.01	90	10
	7/31	100	2.41	88	12
	8/4	100	2.90	31	69
	8/7	100	2.71	12	88
	8/13	100	2.43	3	97
2	7/24	100	.19	100	0
	7/28	100	1.44	100	0
	7/31	100	2.35	100	0
	8/4	100	2.59	49	51
	8/7	100	2 65	20	80
	8/13	100	2.53	7	93
3	7/24	100	05	100	0
	7/28	99	1 11	100	0
	7/31	100	2.44	100	0
	8/4	100	2.51	60	40
	8/7	100	2.51	30	70
	8/13	100	2.31	7	93
4	7/24	100	.00	0	0
	7/28	100	.01	100	0
	7/31	100	.82	100	0
	8/4	100	2.18	100	0
	8/7	100	2.40	76	24
	8/13	100	2.30	35	65
VICTORY GOLDEN					
Planting					
1	7/24	97	.17	100	0
	7/28	100	1.06	100	0
	7/31	100	1.82	94	6
	8/4	100	2.62	58	42
	8/7	100	2.35	21	79
	8/13	100	2.50	11	89
2	7/24	100	.00	0	0
	7/28	97	1.05	100	0
	7/31	100	2.00	100	0
	8/4	100	2.61	51	49
	8/7	100	2.39	26	74
	8/13	100	2.22	7	93
3	7/24	98	.00	0	0
	7/28	100	.18	100	0
	7/31	100	1.63	100	0
	8/4	100	2.54	81	19
	8/7	100	2.43	48	52
	8/13	100	2.56	14	86
4	7/24	90	.00	0	0
	7/28	99	.00	0	0
	7/31	100	.22	100	0
	8/4	100	2.06	100	0
	8/7	100	2.41	99	1
	8/13	100	2.58	25	75

APPENDIX TABLE C.—Some Plant and Ear Characteristics of Corn During Maturation. 1955

	Observation date	Percent in tassel	No. of ears per plant	Percent green silk	Percent dry silk
TENDERMOST					
Planting and Date					
1	7/19	100	.10	100	0
5/13/55	7/22	100	.66	100	0
	7/26	100	1.34	100	0
	7/31	100	1.38	83	17
	8/3	100	1.02	59	41
	8/8	100	1.04	2	98
2	7/22	100	.02	100	0
5/21/55	7/26	100	.60	100	0
	7/31	100	.78	97	3
	8/3	100	.88	82	18
	8/8	100	1.00	10	90
3	7/26	100	.00	0	0
5/26/55	7/31	100	.66	100	0
	8/3	100	.74	100	0
	8/8	100	.84	86	14
	8/18	100	,98	6	94
4	7/26	100	.00	0	0
6/2/55	7/31	100	.10	100	0
	8/3	100	.96	100	0
	8/8	100	1.24	97	3
	8/18	100	1.18	2	98
VICTORY GOLDEN					
Planting and Date					
1	7/19	100	.10	100	0
5/13/55	7/22	100	.46	100	0
	7/26	100	1.48	100	0
	7/31	100	1.38	78	22
	8/3	100	1.24	40	60
	8/8	100	1.12	2	98
2	7/22	100	.00	0	0
5/21/55	7/26	100	.72	100	0
	7/31	100	1.20	92	8
	8/3	100	1.24	73	27
	8/8	100	1.10	11	89
3	7/26	100	.00	0	0
5/26/55	7/31	100	1.08	100	0
	8/3	100	1.20	100	0
	8/8	100	1.04	60	40
	8/18	100	1.08	0	100
4	7/26	80	.00	0	0
6/2/55	7/31	100	.08	100	0
	8/3	100	1.06	100	0
	8/8	100	1.56	99	1
	8/18	100	1.46	1	99

APPENDIX TABLE D.—Heat Unit, Yield and Quality of Sweet Corn for Variety and Plantings and Harvests (Based on entire lots). 1953

Harvest	Days from planting	Heat units	Gross weight (unhusked)	Class A			Class B			Class C		
				Percent A	Percent* C–O	** AIS	Percent B	Percent* C–O	** AIS	Percent C	Percent* C–O	** AIS
TENDERMOST—1953												
Planting 1												
1	81	1960	402	100	21	18.3	----	----	----	----	----	----
2	83	2050	332	100	20	16.3	----	----	----	----	----	----
3	85	2103	332	100	22	23.9	----	----	----	----	----	----
4	90	2193	273	96	36	23.3	4	----	----	----	----	----
Planting 2												
1	86	2086	223	87	28	21.3	13	41	26.1	----	----	----
2	89	2154	268	83	32	23.9	17	36	29.2	----	----	----
3	92	2205	426	67	34	25.9	33	40	30.1	----	----	----
4	94	2258	253	78	45	28.8	19	47	33.7	3	----	----
Planting 3												
1	91	2243	337	90	40	25.6	8	48	33.5	2	----	----
2 & 3	93	2301	586	97	37	26.6	2	42	35.3[1]	1	----	----
4	95	2373	224	82	49	29.5	11	39	31.6	7	46	35.7
Planting 4												
1 & 2	96	2386	772	21	41	32.7	35	39	33.6	44	42	36.5
X		2192.7	316.3	83.4	33.8	24.7	16.4	41.5	31.6	13.8	44	36.1

[1]RP AIS Value.
*Percent cut-off calculated on basis of unhusked corn.
**AIS of corn taken from the cutter sample values.

APPENDIX TABLE D.—Heat Unit, Yield and Quality of Sweet Corn for Variety and Plantings and Harvests (Based on entire lots). 1953—Continued

Harvest	Days from planting	Heat units	Gross weight (unhusked)	Class A			Class B			Class C		
				Percent A	Percent* C–O	** AIS	Percent B	Percent* C–O	** AIS	Percent C	Percent* C–O	** AIS
VICTORY GOLDEN												
Planting 1												
1	81	1960	----	100	----	15.4	----	----	----	----	----	----
2	83	2050	466	100	16	16.9	----	----	----	----	----	----
3	85	2103	431	100	23	20.2	----	----	----	----	----	----
4	88	2165	290	97	29	24.0	3	----	----	----	----	----
Planting 2												
1	84	2051	318	100	24	22.0	----	----	----	----	----	----
2	86	2086	282	66	27	25.3	34	32	26.3	----	----	----
3	89	2154	353	27	27	25.4	65	31	29.0	8	31	26.4
4	91	2205	282	23	22	24.5	65	27	31.2	12	30	31.4
Planting 3												
1	86	2099	220	91	30	21.6	9	38	25.1	----	----	----
2	88	2152	288	98	24	22.7	2	----	----	----	----	----
3	91	2243	340	77	31	23.6	23	32	31.5	----	----	----
4	93	2301	88	53	36	26.8	33	28	29.1	14	37	32.6
Planting 4												
1	89	2249	468	38	38[2]	26.5	50	25[2]	27.8	12	12[2]	31.4[1]
2	91	2311	443	16	34	27.3	41	38	29.0	43	37	33.0
X		2152.1	328.4	70.4	27.2	23.0	32 5	31.4	28.6	17.8	29.4	31
Grand X		2170.8	347.9	76.4	30 4	23 8	24 9	36.4	30.1	16.0	33.6	32.4

[1]RP AIS Value.
[2]Percent cut-off caluclated from a graded 50 lb. sample.
*Percent cut-off calculated on basis of unhusked corn.
**AIS of corn taken from the cutter sample values.

APPENDIX TABLE E.—Heat Unit, Yield and Quality of Sweet Corn for Variety and Plantings and Harvests (Based on 100 lb. lots). 1954

Harvest	Days from planting	Heat units	Gross weight (unhusked)	Class A			Class B			Class C		
				Percent A	Percent* C–O	** AIS	Percent B	Percent* C–O	** AIS	Percent C	Percent* C–O	** AIS
TENDERMOST—1954												
Planting 1												
1	82	1843	410	100	18	13.8	----	----	----	----	----	----
2	86	1904	564	100	22	20.8	----	----	----	----	----	----
3	89	1980	534	100	28	19.7	----	----	----	----	----	----
4	95	2126	502	95	29	28.0	5	----	31.5	----	----	----
Planting 2												
1	85	1963	623	100	27	21.6	----	----	----	----	----	----
2	87	2010	550	100	28	23.4	----	----	----	----	----	----
3	94	2197	508	88	30	25.3	10	----	32.4	2	----	----
4	99	2295	458	30	----	30.4[1]	62	35	34.0	8	----	37.4
Planting 3												
1	89	2099	538	97	32	24.7	3	----	31.1	----	----	----
2 & 3	94	2216	1132	66	36	27.8	30	36	30.6	4	----	34.1
4	104	2436	369	7	----	----	39	53[3]	37.5	54	38[3]	40.8
Planting 4												
1 & 2	88	2133	1069	68	37	26.7	31	37	31.8	1	----	----
3	92	2244	360	29[2]	37	23.6	64	37	33.0	7	----	----
4	96	2315	302	14	----	30.4	52	----	35.7	34	----	----
X		2125.8	494.9	71.0	29.4	24.3	32.9	39.6	33.1	15.7	38	38.0

APPENDIX TABLE E.—Heat Unit, Yield and Quality of Sweet Corn for Variety and Plantings and Harvests (Based on 100 lb. lots). 1954—Continued

Harvest	Days from planting	Heat units	Gross weight (unhusked)	Class A			Class B			Class C		
				Percent A	Percent* C–O	** AIS	Percent B	Percent* C–O	** AIS	Percent C	Percent* C–O	** AIS
VICTORY GOLDEN												
Planting 1												
1	89	1980	708	100	21	17.8	----	----	----	----	----	----
2	90	2002	789	100	22	21.1	----	----	----	----	----	----
3	92	2049	803	100	23	22.1	----	----	----	----	----	----
4	99	2236	813	60	27	26 1	36	----	30.5[1]	4	----	----
Planting 2												
1	90	2087	934	100	27	22.8	----	----	----	----	----	----
2	92	2148	1014	98	30	26.0	2	----	----	----	----	----
3 & 4	97	2265	1531	30	29	27.6	65	29	29.9	5	----	33.2
Planting 3												
1 & 2	96	2246	1773	27	----	28.2	68	29	29.8	5	30	34.3
3	102	2398	700	3	----	----	44	35	31.0	53	37	35.2
Planting 4												
1	88	2133	1275	32	35	27.5	66	30	28.4	2	----	----
2	94	2282	1156	7	30[3]	28.1	48	32	31.4	45	30	35
4	96	2315	1296	4	----	----	27	----	32.6	69	----	38
X		2178.4	913.7	55.1	27.1	24.7	44.5	31.0	30.5	26.1	32.3	35.1
Grand X		2150.1	690.4	63.6	28.4	24.5	38.4	35.3	32.0	20.9	33.8	36.4

[1]Raw product (inspectors 50# sample) AIS Value.
[2]Percent class figured from inspectors 50# sample.
[3]Percent cut-off based on lot less than 100 pounds.
*Percent cut-off calculated on the basis of unhusked corn.
**AIS of corn taken from the cutter sample values.

APPENDIX TABLE F.—Heat Unit, Yield and Quality of Sweet Corn for Variety and Plantings and Harvests 1955

Harvest		Days from planting	Heat units	Gross weight (unhusked)	Class A		AIS	Class B		AIS	Class C
					Percent A	Percent C–O[2]		Percent B	Percent C–O[2]		Percent C
TENDERMOST											
Planting 1	1	87	1878	528	100	----	----	----	----	----	----
	2	88	1956	584	100	25[1]	18.6[1]	----	----	----	----
	3	90	2015	558	100	30	21.0	----	----	----	----
	4	94	2098	754	97	31	25.2	3	----	----	----
Planting 2	1	86	2002	738	100	35[1]	22.3	----	----	----	----
	2	89	2093	878	100	29	25.1	----	----	----	----
	3	90	2125	995	99	36	25.1	1	----	----	----
	4	94	2238	953	82	41	26.4	18	----	----	----
Planting 3	1	89	2132	801	93	37	25.0	7	----	----	----
	2	92	2189	892	65	37	28.2	32	33	29.7	3
	3	95	2277	852	28	31	29.8	54	32	29.6	18
Planting 4	1	82	2052	906	87	30	24.3	13	----	----	----
	2	85	2120	854	60	34	26.7	40	34	27.1	----
	3	88	2206	872	19	32	29.2	77	32	30.7	4
	X	89.2	2098.6	797.5	80.7	32.9	25.1	27.2	32.8	29.3	8
VICTORY GOLDEN											
Planting 1	1	88	1956	765	100	19[1]	18.9[1]	----	----	----	----
	2	90	2015	788	100	23	22.1	----	----	----	----
	3	94	2098	844	82	23	26.8	18	----	----	----
	4	97	2189	748	70	33	27.2	30	35	28.1	1
Planting 2	1	90	2125	800	80	26	24.5	20	----	----	----
	2	95	2254	838	7	----	----	87	----	26.8	6
Planting 3	1	88	2110	1143	98	32	22.4	2	----	----	----
	2	90	2148	1112	64	30[1]	25.8	35	30	25.0	1
	3	92	2189	1144	24	36	26.9	73	31	26.8	3
Planting 4	1	81	2036	1156	99	24	20.4	1	----	----	----
	2	85	2120	1056	30	29	21.8	69	24	26.1	1
	3	87	2181	9990	7	----	----	88	31	27.2	5
	X	89.8	2118.4	948.7	63.4	27.5	23.7	42.3	30.2	26.7	3
Grand	X	89.4	2107.8	867.3	72.7	30.6	24.5	35.2	31.3	27.7	4.9

[1]Average values from more than one lot.

[2]Percent cut-off calculated on the basis of 100# lots and also on the basis of unhusked corn.

APPENDIX TABLE G.—Grade Relationship of Canned Whole Kernel Yellow Sweet Corn By Raw Product Classification, Variety, Year and Cuttings

Variety	Year	Repl.	Cutting	U. S. D. A. Score Points						
				Color	Cut	Absence of defects	Tend. and mat.	Flavor	Total score	Grade
Raw Products Class A										
Tendermost	1953	10	1	8.70	8.50	17.90†	35.75†	17.95	88.80	B
		10	2	8.90	8.60	18.60	35 75†	17.50	89.40	B
		6	3	8.83	8.00	17.83†	34.67†	17.60	86.50	B
		26	Av.	8.83	8.42	18.15	35.50†	17.60	88.50	B
	1954	11	1	8.64	8.09	17.54†	33.64†	16.27	84.18	B
		11	2	8 91	8.82	18.91	31.64†	14.18†	82.45	C
		11	3	8.57	8.00	18.95	33.19†	15.76†	84.48	C
		33	Av.	8.71	8.30	18.47	32.82†	15.40†	83.70	C
	1955	15	1	9.47	8.47	19.00	35.93†	17.93	90.80	B
		15	2	9.47	8.07	18.87	36.00	18.00	90.40	A
		30	Av	9.47	8.27	18.94	35.97†	17.97	90.60	B
Av. for 3 years		89		9.00	8.32	18.53	34.66†	16.91	87.43	B
Victory Golden	1953	12	1	8.88	8.54	17.92†	36.33	18.25	89.88	B
		12	2	8.92	8.75	18.42	36.12	17.79	90.00	A
		9	3	8.78	7.89†	17.72†	35.33†	17.33	87.06	B
		33	Av.	8.87	8.44	18.05	35.98†	17.83	89.15	B
	1954	10	1	8.90	8.00	17.60†	34.60†	16.90	86.00	B
		10	2	8.90	8.90	18.90	33.20†	16.10	86.00	B
		10	3	8.74	8.10	19.00	34.74†	16.95	87.53	B
		30	Av.	8.85	8.33	18.50	34.18†	16.65	86.51	B
	1955	13	1	9.62	8.62	18.92	37.12	19.31	93.58	A
		13	2	9.62	8.15	18.96	38.15	19.23	94.12	A
		26	Av.	9.62	8.39	18.94	37.64	19.27	93.85	A
Av for 3 years		89		9.08	8.39	18.46	35.86†	17.85	89.63	B
Av. by year	1953	59		8.85	8.43	18.09	35.77†	17.73	88.86	B
	1954	63		8.78	8.31	18.48	33.47†	16.00	85.04	B
	1955	56		9.54	8.32	18.94	36.74	18.57	92.11	A
Av. by maturity class		178		9.04	8.36	18.50	35.26†	17.38	88.47	B

†Indicates limiting rule.

APPENDIX TABLE G.—Grade Relationship of Canned Whole Kernel Yellow Sweet Corn By Raw Product Classification, Variety, Year and Cuttings—Continued

Variety	Year	Repl.	Cutting	U. S. D. A. Score Points: Color	Cut	Absence of defects	Tend. and mat.	Flavor	Total score	Grade
Raw Products Class B										
Tendermost	1953	5	1	9.40	8.90	18.60	30.70†	14.20†	81.80	C
		4	2	9.50	9.00	18.62	31.12†	14.88†	83.12	C
		3	3	9.33	8.00	18.33	27.00†	14.00†	76.67	D
		12	Av.	9.42	8.71	18.54	29.91†	14.38†	80.96	D
Tendermost	1954	6	1	7.83*	8.00	16.50†	26.67†	11.00†	70.00	D
		6	2	8.83	8.50	18.25	25.67†	10.50†	71.75	D
		6	3	7.00*	8.00	18.83	20.67†	9.67†	64.17	D
		18	Av.	7.89*	8.20	17.86†	24.34†	10.39†	68.64	D
	1955	4	1	9.00	8.25	18.38	33.50†	16.00	85.12	B
		4	2	9.25	8.25	18.75	32.75†	16.00	85.00	B
		8	Av.	9.13	8.25	18.57	33.13†	16.00	85.06	B
Av. for 3 years		38		8.63	8.37	18.22	27.95†	12.83†	75.99	D
Victory Golden	1953	6	1	8.83	8.75	18.33	34.58†	17.33	87.83	B
		5	2	9.50	9.00	18.70	34.50†	17.20	88.90	B
		4	3	9.00	8.00	18.00	32.00†	15.43†	82.43	B
		15	Av.	9.10	8.63	18.36	33.86†	16.78	86.75	B
	1954	5	1	8.00	8.00	17.40†	29.40†	13.60†	76.40	D
		5	2	9.00	9.00	19.00	28.70†	13.00†	78.70	D
		5	3	7.44*	8.00	19.00	30.11†	13.84†	78.44	D
		15	Av.	8.15	8.33	18.47	29.40†	13.48†	77.85	D
	1955	5	1	10.00	8.40	19.00	34.60†	17.60	89.60	B
		6	2	9.67	8.33	19.00	36.00	18.50	91.50	A
		11	Av.	9.82	8.36	19.00	35.36†	18.09	90.64	B
Av. for 3 years		41		8.94	8.45	18.57	32.63†	15.92†	84.54	C
Av. by year	1953	27		9.24	8.66	18.44	32.10†	15.71†	84.18	C
	1954	33		8.01	8.26	18.14	26.64†	11.79†	72.83	D
	1955	19		9.53	8.31	18.82	34.42†	17.21	88.29	B
Av. by maturity class				8 80	8.41	18.40	30.38†	14.44†	80.42	C

*Indicates partial limiting rule.
†Indicates limiting rule.

APPENDIX TABLE G.—Grade Relationship of Canned Whole Kernel Yellow Sweet Corn By Raw Products Classification, Variety, Year and Cuttings—Concluded

Variety	Year	Repl.	Cutting	U. S. D. A. Score Points: Color	Cut	Absence of defects	Tend. and mat.	Flavor	Total score	Grade
Raw Products Class C										
Tendermost	1953	1	1	10.00	9.00	19.00	27.50†	10.00†	75.50	D
	1954	2	1	7.50*	8.00	17.00†	20.00†	7.50†	60.00	D
		2	2	8.00	9.00	19.00	18.50†	5.50†	60.00	D
		2	3	8.00	8.00	18.50	19.50†	9.00†	63.00	D
		6	Av.	7.83*	8.33	18.17	19.33†	7.33†	61.00	D
Av. for 2 years		7		8.14	8.42	18.29	20.50†	7.71†	63.07	D
Victory Golden	1953	2	1	8.75	8.75	18.25	33.00†	16.25	85.00	B
		1	2	9.00	9.00	18.50	34.50†	17.00	88.00	B
		3	Av.	8.83	8.83	18.33	33.50†	16.50	86.00	B
	1954	1	1	7.50*	8.00	17.50†	17.50†	7.50†	58.00	D
		4	2	9.25	8.75	18.38	27.00†	11.25†	74.62	D
		3	3	7.00*	8.00	19.00	26.60†	11.20†	71.80	D
		8	Av.	8.19	8.38	18.50	25.66†	10.76†	71.48	D
Av. for 2 years		11		8.36	8.50	18.45	27.80†	12.32†	75.44	D
Av. by year	1953	4		9.12	8.87	18.50	32.00†	14.88†	83.38	D
	1954	14		8.04	8.36	18.36	22.95†	9.29†	66.99	D
Av. by maturity class				8.28	8.47	18.39	24.96†	10.66†	70.63	D

*Indicates partial limiting rule.
†Indicates limiting rule.

APPENDIX TABLE H.—Grade Relationship of Frozen Whole Kernel Yellow Sweet Corn By Raw Product Grade, Variety and Year By Cutting

Variety	Year	Repl.	Cutting	U. S. D. A. Score Points				
				Color	Absence of defects	Tenderness and material	Total score	Grade
Raw Products Class A								
Tendermost	1953	9	1	9.00	36.78	46.33	92.11	A
		8	2	9.12	38.44	46.81	94.38	A
		8	3	9.40	38.33	47.27	95.00	A
		25	Av.	9.17	37.81	46.78	93.76	A
	1954	11	1	9.36	37.18	46.00	92.54	A
		11	2	8.73	38.45	45.09	92.27	A
		11	3	9.00	38.91	44.36†	92.27	B
		33	Av.	9.03	38.18	45.15	92.36	A
	1955	13	1	9.62	38.65	45.46	93.73	A
		13	2	9.96	39.00	47.65	96.62	A
		26	Av.	9.79	38.82	46.56	95.18	A
Average for 3 years		84		9.31	38.27	46.07	93.65	A
Victory Golden	1953	11	1	8.82	37.36	46.59	92.77	A
		10	2	8.75	38.05	47.95	94.75	A
		10	3	8.89	37.72	48.11	94.72	A
		31	Av.	8.82	37.70	47.52	94.04	A
	1954	10	1	9.10	36.90	46.80	92.80	A
		10	2	9.00	38.05	46.30	93.35	A
		10	3	8.70	38.90	43.50†	91.10	B
		30	Av.	8.93	37.95	45.53	92.42	A
	1955	11	1	9.45	38.95	47.09	95.50	A
		13	2	9.96	39.00	48.62	97.58	A
		24	Av.	9.73	38.98	47.92	96.63	A
Average for 3 years		85		9.12	38.15	46.93	94.20	A
Average by year	1953	56		8.98	37.75	47.19	93.92	A
	1954	63		8 98	38.07	45.33	92.39	A
	1955	50		9.76	38.90	47.21	95.88	A
Grand average		169		9.21	38.21	46.50	93.93	A

†Limiting rule.

APPENDIX TABLE H.—Grade Relationship of Frozen Whole Kernel Yellow Sweet Corn by Raw Product Grade, Variety and Year By Cutting—Continued

Variety	Year	Repl.	Cutting	U. S. D. A. Score Points: Color	Absence of defects	Tenderness and material	Total score	Grade
Raw Products Class B								
Tendermost	1953	7	1	9.00	37.44	39.93†	86.36	C
		7	2	8.92	38.58	38.67†	86.17	C
		7	3	8.80	38.00	41.40†	88.20	B
		21	Av.	8.91	38.01	40.00†	86.91	B
	1954	6	1	8.00	35.67†	31.33†	75.00	D
		6	2	8.33	38.17	34.67†	81.17	D
		6	3	7.17*	38.67	25.83†	71.67	D
		18	Av.	7.83*	37.50	30.61†	75.95	D
	1955	5	1	9.40	38.80	44.00†	92.20	B
		5	2	10.00	39.00	45.80	94.80	A
		10	Av.	9.70	38.90	44.90†	93.50	B
Average for 3 years		49		8.67	38.00	37.55†	84.23	C
Victory Golden	1953	4	1	8.88	36.38	44.62†	89.88	B
		4	2	8.50	38.38	46.75	93.62	A
		4	3	9.00	38.25	45.75	93.00	A
		12	Av.	8.79	37.67	45.71	92.17	A
	1954	5	1	8.60	36.60	39.60†	84.80	C
		5	2	8.60	38.50	40.40†	83.50	B
		5	3	7.20*	38.40	31.20†	76.80	D
		15	Av.	8.13	37.83	37.07†	83.03	C
	1955	5	1	9.60	39.00	45.80	94.40	A
		4	2	10.00	39.00	47.25	96.25	A
		9	Av.	9.78	39.00	46.44	95.22	A
Average for 3 years		40		8.76	38.03	42.63†	89.43	B
Average by year	1953	37		8.86	37.86	42.47†	89.18	B
	1953	33		7.97	37.65	33.55†	79.17	D
	1955	19		9.74	38.95	45.63	94.31	A
Average by maturity class		89		8.72	38.01	39.84†	86.57	C

†Limiting rule.

APPENDIX TABLE H.—Grade Relationship of Frozen Whole Kernel Yellow Sweet Corn By Raw Product Grade, Variety and Year By Cutting—Concluded

Variety	Year	Repl.	Cutting	U. S. D. A. Score Points: Color	Absence of defects	Tenderness and material	Total score	Grade
Raw Products Class C								
Tendermost	1953	2	1	7.75*	37.50	28.25†	73.50	D
		1	2	8.00	35.00†	30.00†	73.00	D
		3	Av.	7.83*	36.67	28.83†	73.33	D
	1954	None						
	1955	None						
Victory Golden	1953	1	1	8.50	35.50†	40.00†	84.00	B
		1	2	8.00	36.00	39.00†	83.00	C
		2	Av.	8.25	35.75†	39.50†	83.50	C
	1954	None						
	1955	None						
Maturity average				8.00	36.30	33.10†	77.40	D

†Limiting rule.

APPENDIX TABLE I.—Summary of Statistical Analyses of the U.S.D.A. Grade Factors for Canned and Frozen Whole Kernel Corn (1953, 1954 and 1955)

Factor	Product	Year	N	Mean (x)	Standard deviation (σ)	Standard error of mean σx	$\sigma 1.4$	Coefficient of variability (V)
Color	Canned	1953	187	8.9	0.70	0.05	0.99	7.87
		1954	113	8.4	0.86	0.08	1.20	10.24
		1955	79	9.5	0.52	0.06	0.73	5.52
		Av.	379	8.9	0.81	0.04	1.14	9.11
	Frozen	1953	177	8.9	0.61	0.05	0.86	6.90
		1954	96	8.6	1.00	0.10	1.40	11.57
		1955	73	9.7	0.50	0.06	0.70	5.11
		Av.	346	9.0	0.82	0.04	1.15	9.16
Absence of defects	Canned	1953	185	18.2	0.74	0.05	1.03	4.04
		1954	112	18.3	0.92	0.09	1.29	5.01
		1955	76	18.9	0.39	0.04	0.55	2.07
		Av.	373	18.4	1.33	0.07	1.86	7.23
	Frozen	1953	177	37.7	1.08	0.08	1.51	2.86
		1954	98	37.9	1.03	0.10	1.42	2.68
		1955	72	38.9	0.41	0.05	0.58	1.06
		Av.	347	38.0	1 28	0.07	1.80	3.38
Tenderness and maturity	Canned	1953	187	34.8	2.67	0.20	3.74	7.68
		1954	101	32.1	4.14	0.41	5.79	12.90
		1955	78	36.0	3.12	0.35	4.36	8.67
		Av.	366	34.3	3.40	0.18	4.75	9.91
	Frozen	1953	177	45.0	4.12	0.31	5.77	9.15
		1954	96	42.9	5.09	0.52	8.26	11.88
		1955	72	46.9	2.47	0.29	3.45	5.26
		Av.	345	44.8	4.38	0.24	6.13	9.77
Cut	Canned	1953	94	9.24	0.82	0.08	1.15	8.90
		1954	115	8.30	0.46	0.04	0.64	5.49
		1955	76	8.33	0.47	0.05	0.66	5.65
		Av.	285	8.37	0.49	0.03	0.69	5.87
Flavor	Canned	1953	94	17.05	1.93	0.20	2.70	11.30
		1954	113	13.80	3.72	0.35	5.20	26.96
		1955	76	18.22	1.60	0.18	2.24	8.78
		Av.	283	16.07	3.36	0.20	4.70	20.91
Total score	Canned	1953	94	87.32	4.51	0.46	6.32	5.17
		1954	117	78.40	10.52	0.97	14.74	13.42
		1955	76	91.10	4.98	0.57	6.98	5.47
		Av.	287	84.69	9.43	0.56	13.20	11.13
	Frozen	1953	94	91.12	5.17	0.53	7.24	5.67
		1954	95	87.98	9.94	1.02	13.91	11.29
		1955	73	95.55	2.55	0.30	3.57	2.67
		Av.	262	91.21	7.52	0.46	10.53	8.24

APPENDIX TABLE J.—Average Percent Moisture (Vac. Oven) Values for Various Sampling Points by Maturity Classification, Variety and Year

Maturity Class	Variety	Year	Sample Points			
			Raw product	Cutter	Washer	Blancher
A	Tendermost	1953	67.19	69.49	70.78	72.96
		1954	68.60	69.80	71.62	72.44
		1955	----	69.34	----	71.98
		Av.	67.96	69.53	71.18	72.42
	Victory Golden	1953	66.07	69.68	71.82	75.58
		1954	69.22	68.88	72.36	73.30
		1955	----	71.05	----	73.49
		Av.	67.56	69.92	72.05	74.13
	Average by maturity Class A		67.77	69.72	71.62	73.24
B	Tendermost	1953	62.26	62.79	64.68	66.46
		1954	61.11	60.15	62.55	64.12
		1955	----	65.14	----	68.32
		Av.	61.68	62.03	63.77	66.09
	Victory Golden	1953	63.94	65.75	66.98	71.20
		1954	63.59	64.98	66.10	68.06
		1955	----	67.55	----	71.14
		Av.	63.79	65.92	66.64	70.20
	Average by maturity Class B		62.58	64.16	65.15	68.02
C	Tendermost	1953	57.23	59.30	59.72	61.89
		1954	56.03	55.61	56.67	61.72
		Av.	56.63	56.84	58.20	61.80
	Victory Golden	1953	61.08	62.03	64.58	67.16
		1954	59.40	59.15	61.84	62.84
		Av.	60.74	60.43	63.36	64.28
	Average by maturity Class C		58.91	58.99	61.77	63.29
	Average disregarding maturity for:					
	Tendermost		64.49	66.00	67.38	69.72
	Victory Golden		65.36	67.27	68.75	70.72
		1953	64 32	66.87	68.30	71.27
		1954	65.53	64.71	67.84	69.20
		1955	----	69.15	----	71.91
	Grand Average		64.88	66.66	68.10	70.79

APPENDIX TABLE K.—Average Percent Soluble Solids Values for Various Sampling Points by Maturity Classification, Variety and Year

Maturity Class	Variety	Year	Sample Points			
			Raw product	Cutter	Washer	Blancher
A	Tendermost	1953	27.31	25.29	22.81	22.19
		1954	26.03	24.90	22.07	20.85
		1955	----	24.04	----	23.90
		Av.	26.61	24.71	22.46	22.45
	Victory Golden	1953	26.02	24.28	22.00	22.29
		1954	26.82	26.76	22.86	21.32
		1955	----	24.65	----	24.28
		Av.	26.40	25.12	22.36	22.72
	Average by maturity Class A		26.51	24.91	22.41	22.58
B	Tendermost	1953	30.61	28.48	26.31	26.96
		1954	28.99	27.38	23.55	23.87
		1955	----	25.55	----	25.42
		Av.	29.80	27.39	25.13	25.59
	Victory Golden	1953	28.91	26.74	24.81	26.96
		1954	29.48	28.16	25.02	24.34
		1955	----	26.90	----	23.32
		Av.	29.15	27.34	24.89	24.78
	Average by maturity Class B		29.52	27.36	25.01	25.21
C	Tendermost	1953	30.50	30.25	28.40	27.85
		1954	29.45	27.22	24.40	23.60
		Av.	29.80	28.23	26.40	25.73
	Victory Golden	1953	31.50	28.50	25.56	27.45
		1954	32.10	28.18	25.65	23.80
		Av.	31.62	28.32	25.60	24.76
	Average by maturity Class C		30.94	28.28	25.85	25.08
	Average disregarding maturity for:					
	Tendermost		28.09	25.88	23.76	22.72
	Victory Golden		28.04	26.31	23.71	23.54
		1953	28.43	26.24	23.98	24.42
		1954	27.68	26.88	23.40	22.36
		1955	----	24.89	----	24.10
	Grand Average		28.06	26.10	23.73	23.60

APPENDIX TABLE L.—Average Percent AIS Values for Various Sampling Points by Maturity Classification, Variety and Year

Maturity class	Variety	Year	Sample Points: Raw product	Cutter	Washer	Blancher	Canned	Frozen
A	Tendermost	1953	25.85	24.68	23.53	22.37	20.58	23.91
		1954	24.45	23.78	23.50	22.70	20.18	23.70
		1955	----	25.15	----	23.31	20.33	24.07
		Av.	25.09	24.71	23.52	22.95	20.35	23.88
	Victory Golden	1953	25.09	23.53	21.68	20.02	19.21	22.94
		1954	24.68	24.73	22.52	23.59	19.70	23.61
		1955	----	23.45	----	21.96	19.07	22.67
		Av.	24.90	23.76	22.03	21.84	19.33	23.11
	Average by Maturity Class A		25.00	24.26	22.76	22.43	19.84	23.50
B	Tendermost	1953	32.21	31.40	30.29	28.82	26.25	28.53
		1954	33.00	33.07	31.68	30.44	25.37	30.47
		1955	----	29.27	----	26.06	23.07	25.87
		Av.	32.58	31.32	30.88	28.26	25.19	28.66
	Victory Golden	1953	29.86	28.61	26.85	24.80	22.50	26.20
		1954	30 50	29.35	28.81	27.27	22.89	27.41
		1955	----	26.65	----	24.73	21.34	25.36
		Av.	30.13	28.03	27.60	25.32	22.31	26.46
	Average by Maturity Class B		31.49	29.52	29.30	26.79	23.70	27.70
C	Tendermost	1953	36.40	36.07	35.64	33.04	26.67	33.29
		1954	38.72	37.98	37.20	36.18	29.38	----
		Av.	37.56	37.34	36.42	34.61	28.99	
	Victory Golden	1953	31.95	30.79	30.28	26.06	24.43	26.90
		1954	36.35	35.83	33.31	31.72	25.56	----
		Av.	32.83	33.59	31.63	29.83	25.30	
	Average by Maturity Class C		34.93	35.09	33.10	31.74	26.59	30.73
	Average disregarding maturity for:							
	Tendermost		29.05	27.64	27.29	25.16	22.20	25.76
	Victory Golden		27.74	26.32	25.48	23.59	20.76	24.18
		1953	28.70	27.09	25.83	23.95	21.43	25.28
		1954	28.13	29.09	26.99	26.42	22.24	25.47
		1955	----	25.35	----	23.45	20.35	24.05
	Grand Average		28.44	26.97	26.33	24.39	21.46	25.01

APPENDIX TABLE M.—Average Percent Pericarp Values for Various Sampling Points by Maturity Classification, Variety and Year

Maturity class	Variety	Year	Sample Points: Raw product	Cutter	Washer	Blancher	Canned	Frozen
A	Tendermost	1953	3.39	3.28	3.64	3.80	1.69	1.92
		1954	2.11	2.07	2.02	2.32	1.53	2.01
		1955	----	1.79	----	1.78	1.45	1.88
		Av.	2.66	2.17	2.75	2.37	1.53	1.94
	Victory Golden	1953	4.15	2.98	3.20	2.77	1.28	1.90
		1954	1.96	2.05	2.06	2.13	1.37	1.91
		1955	----	1.71	----	1.61	1.21	1.73
		Av.	3.12	2.05	2.60	2.21	1.29	1.85
	Average by Maturity Class A		2.86	2.12	2.68	2.31	1.41	1.90
B	Tendermost	1953	6.07	5.52	5.37	5.02	2.93	3.06
		1954	2.94	2.97	3.07	4.38	2.08	2.64
		1955	----	2.01	----	2.01	1.65	2.01
		Av.	4.40	3.30	4.12	3.69	2.18	2.63
	Victory Golden	1953	4.94	5.35	4.70	3.95	1.61	2.11
		1954	2.70	2.61	2.90	2.99	1.78	2.21
		1955	----	1.87	----	1.93	1.52	2.12
		Av.	4.01	2.69	3.58	2.63	1.65	2.16
	Average by Maturity Class B		4.23	2.98	3.89	3.15	1.91	2.42
C	Tendermost	1953	7.85	4.95	9.14	7.79	4.70	5.50
		1954	4.31	4.45	4.42	8.72	2.65	----
		Av.	6.08	4.62	5.99	8.26	2.94	5.50
	Victory Golden	1953	6.52	6.99	4.78	5.23	2.79	2.60
		1954	4.34	3.82	3.74	4.14	2.39	----
		Av.	6.08	4.72	3.95	4 50	2.43	2.60
	Average by Maturity Class C		6.08	4.67	4.72	6.00	2.63	4.53
	Average disregarding maturity for:							
	Tendermost		3.65	2.70	3.48	3.07	1.80	2.23
	Victory Golden		3.87	2.53	3.06	2.62	1.50	1.95
		1953	4.91	4.22	4.16	4.06	1.79	2.32
		1954	2.53	2.70	2.62	3.21	1.75	2.12
		1955	----	1.80	----	1.78	1.40	1.88
	Grand Average		3.75	2.62	3.28	2.84	1.65	2.10

APPENDIX TABLE N.—Average Succulometer Values for Various Sampling Points by Maturity Classification, Variety and Year

Maturity class	Variety	Year	Sample Points: Raw product	Cutter	Washer	Blancher	Canned	Frozen
A	Tendermost	1953	12.33	15.78	21.12	13.70	16.13	21.16
		1954	13.83	16.26	21.57	15.34	18.72	21.91
		1955	----	16.02	----	13.47	18.19	23.79
		Av.	13.15	16.02	21.34	14.11	17.78	22.35
	Victory Golden	1953	13.86	16.58	21.59	14.27	17.15	23.16
		1954	15.78	16.45	23.57	15.50	21.69	23.06
		1955	----	18.34	----	13.81	20.40	24.14
		Av.	14.77	17.11	22.42	14.69	19.61	23.40
	Average by Maturity Class A		13.90	16.53	21.89	14.35	18.69	22.86
B	Tendermost	1953	5.62	9.50	13.15	7.62	11.64	14.73
		1954	6.06	9.11	13.17	8.00	13.42	14.49
		1955	----	11.72	----	9.95	15.10	20.30
		Av.	5.84	9.77	13.16	8.26	13.13	15.80
	Victory Golden	1953	8.46	12.10	18.25	10.50	14.50	18.68
		1954	8.40	12.39	15.60	11.30	18.55	19.18
		1955	----	16.08	----	15.70	19.17	21.36
		Av.	8.44	13.25	17.23	12.70	17.28	19.61
	Average by Maturity Class B		6.95	11.63	15.12	10.35	15.26	17.46
C	Tendermost	1953	2.25	4 25	8.75	5.50	11.00	10.15
		1954	2.25	5.50	9.75	4.25	11.42	----
		Av.	2.25	5.08	9.25	4.88	11.36	10.15
	Victory Golden	1953	5.00	7.30	14.10	9.50	13.83	16.00
		1954	3.00	5.90	12.75	8.25	16.44	----
		Av.	4.60	6.52	13.50	8.67	15.84	16.00
	Average by Maturity Class C		3.56	5.94	12.19	7.15	14.27	12.49
	Average disregarding maturity for:							
	Tendermost		9.33	13.04	17.37	11.66	16.08	19.84
	Victory Golden		11.25	14.32	19.21	13.24	18.72	22.15
		1953	9.53	13.17	18.26	11.57	15.42	19.60
		1954	10.97	12.34	18.43	12.36	18.01	20.51
		1955	----	16.27	----	13.56	18.78	23.11
	Grand Average		10.21	13.69	19.34	12.37	17.36	20.92

APPENDIX TABLE O.—Average Specific-Gravity Values for Corresponding Raw and Canned Whole Kernel Corn Lots Classified According to U. S. Canned Grades (1954 and 1955)

U. S. Grade	Variety	Year	Sample Points				
			Cutter		Blancher		Canned
			100 g.	6 lb.	100 g.	6 lb.	100 g.
A	Tendermost	1954	----	----	----	----	1.073
		1955	1.093	1.095	1 090	1.092	1.079
	Victory Golden	1954	----	----	----	----	1.069
		1955	1.097	1.101	1 093	1 094	1.078
		Average	1.095	1.099	1 092	1.093	1.077
B	Tendermost	1954	----	----	----	----	1.085
		1955	1.106	1.111	1 103	1.107	1.091
	Victory Golden	1954	----	----	----	----	1.081
		1955	1.105	1.110	1.098	1.101	1.087
		Average	1.105	1.110	1.101	1 104	1 087
C	Tendermost	1954	----	----	----	----	1.094
		1955	1.110	1.115	1 105	1.113	1.096
	Victory Golden	1954	----	----	----	----	1.090
		1955	----	----	----	----	----
		Average	1.110	1.115	1.105	1.113	1.092
	Grand Average		1.100	1.104	1.096	1.098	1.083

APPENDIX TABLE P.—Average Specific-Gravity Values for Corresponding Raw and Frozen Whole Kernel Corn Lots Classified According to U. S. Frozen Grades (1954 and 1955)

U. S. Grade	Variety	Year	Sample Points				
			Cutter		Blancher		Frozen
			100 g.	6 lb.	100 g.	6 lb.	100 g.
A	Tendermost	1954	----	----	----	----	1.084
		1955	1 099	1.103	1.096	1.098	1 097
	Victory Golden	1954	----	----	----	----	1.082
		1955	1 098	1.102	1.094	1.095	1.095
		Average	1.098	1.103	1.095	1 096	1.092
B	Tendermost	1954	----	----	----	----	1.105
		1955	1.108	1.114	1.104	1.112	1.106
	Victory Golden	1954	----	----	----	----	1.100
		1955	1.116	1.112	1 104	1 103	1.109
		Average	1.110	1.114	1.104	1 110	1.104
C	Tendermost	1954	----	----	----	----	1.113
	Victory Golden	1954	----	----	----	----	1.097
		Average	----	----	----	----	1.102
	Grand Average		1.110	1.104	1.096	1.099	1.096